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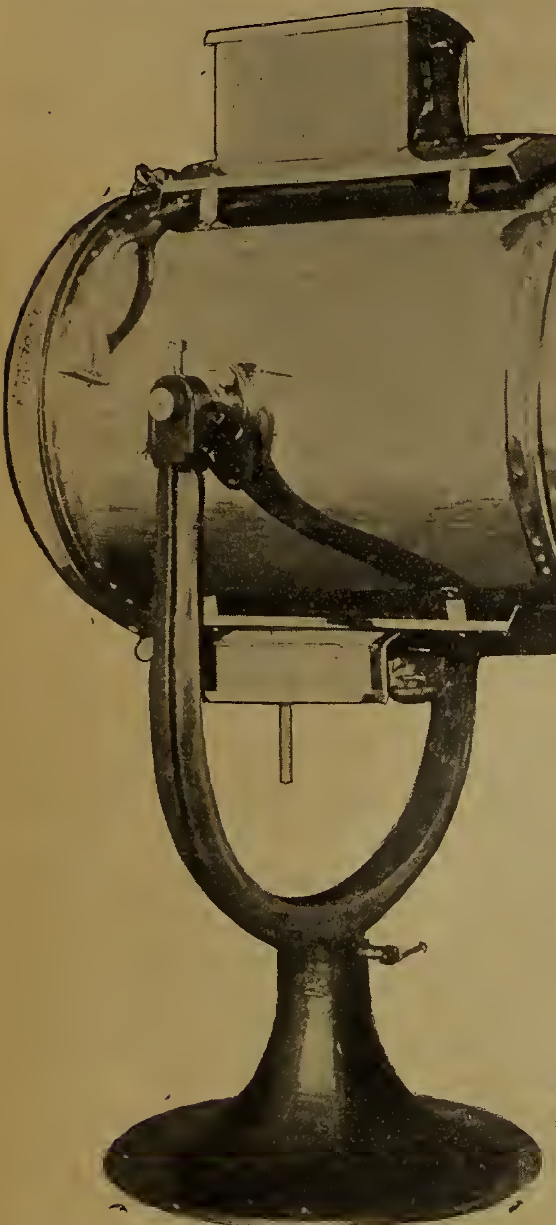

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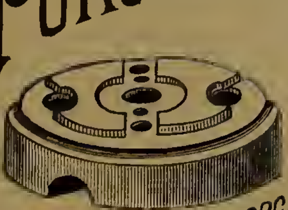

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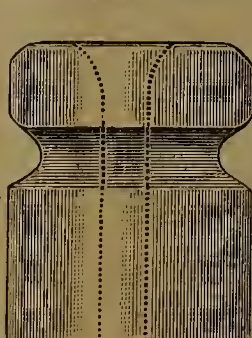

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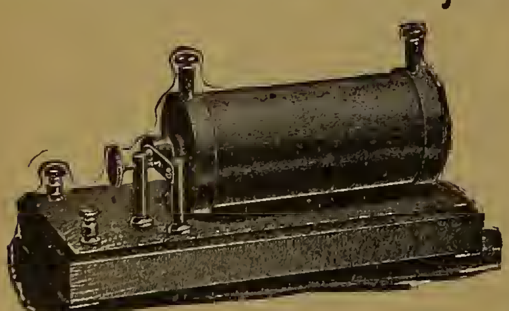

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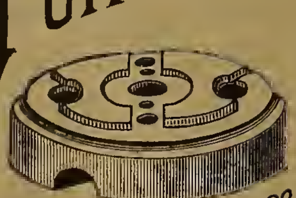

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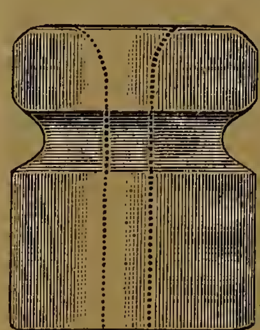

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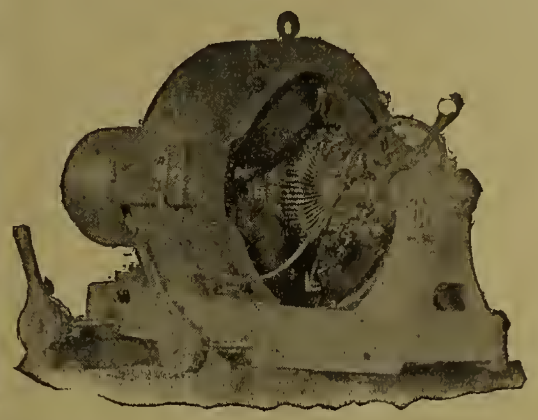

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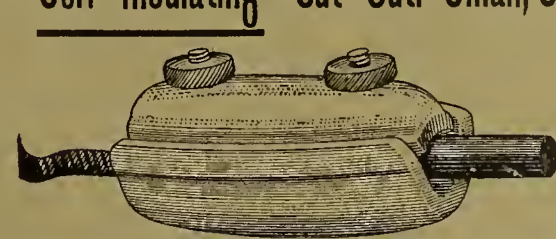

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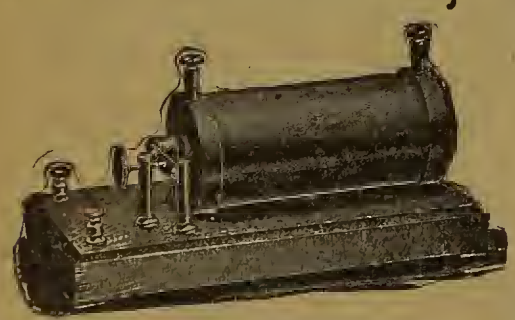

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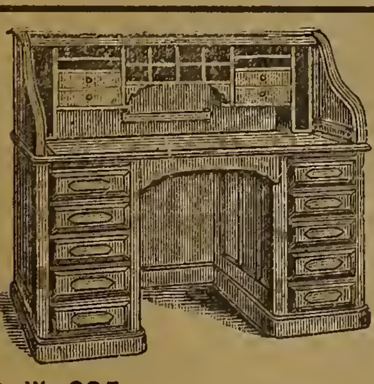

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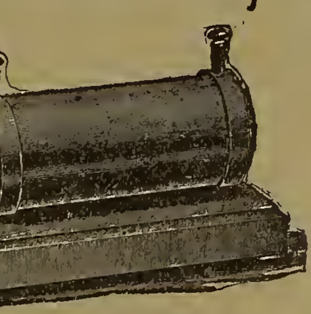

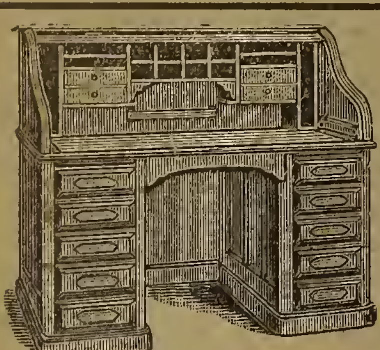

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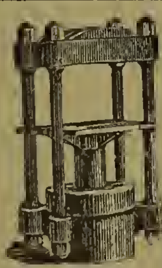

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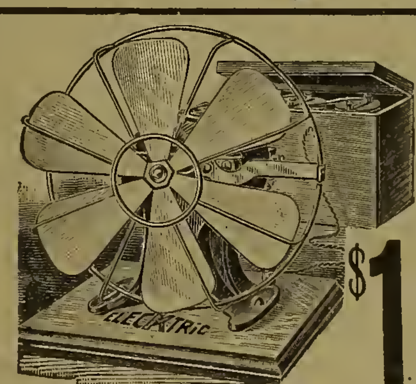

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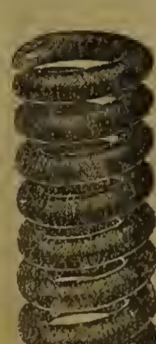

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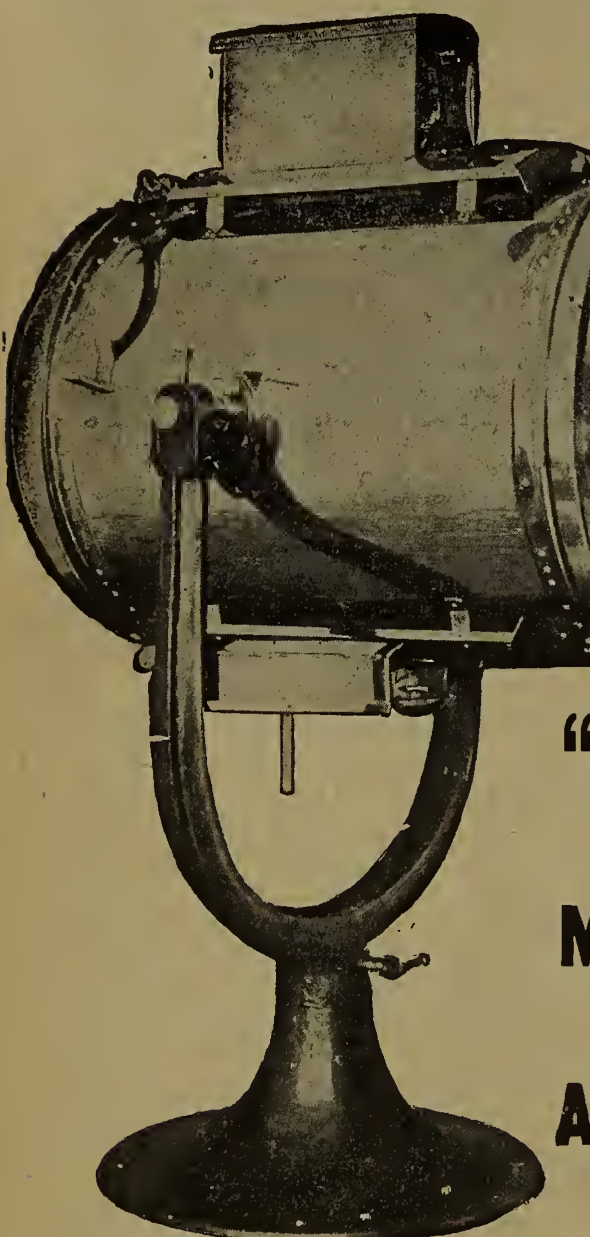

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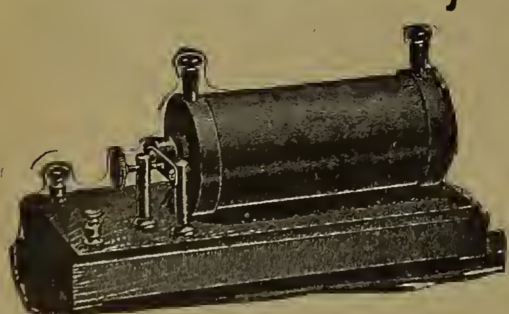

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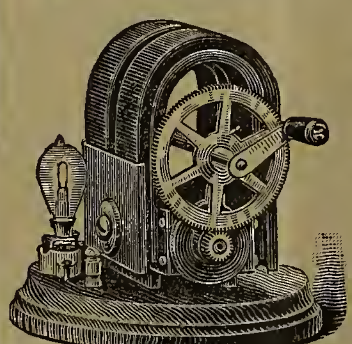

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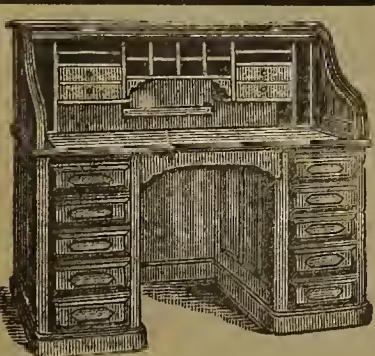

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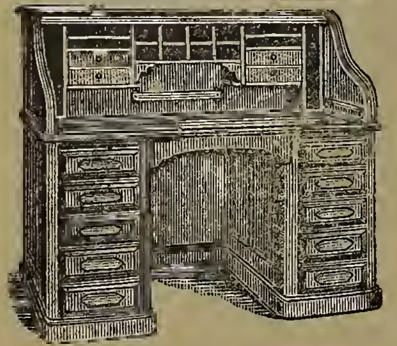

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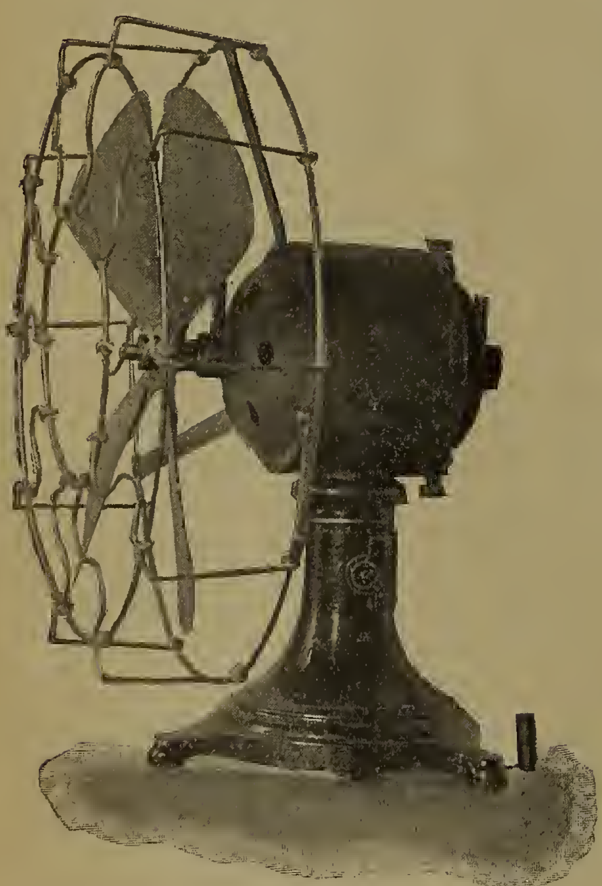

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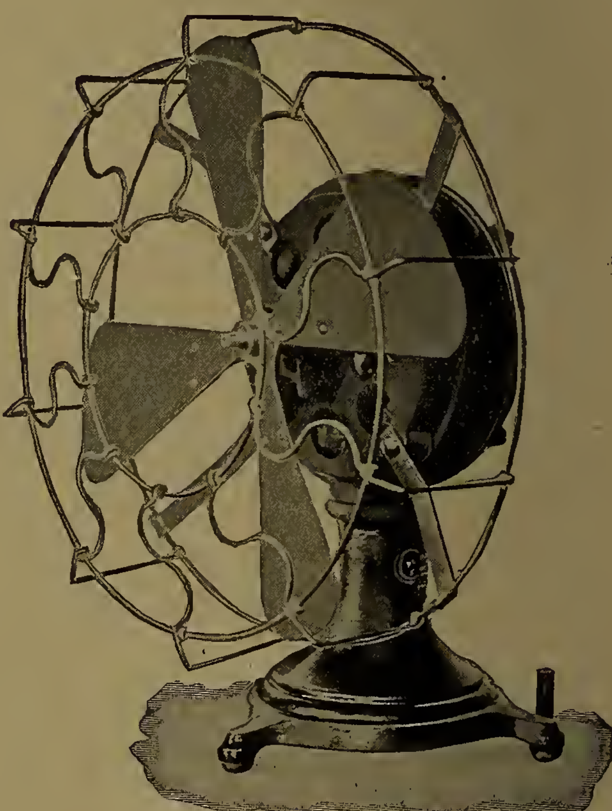

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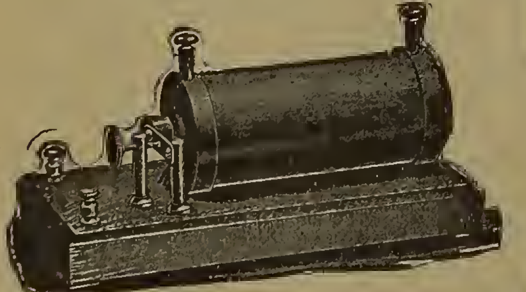

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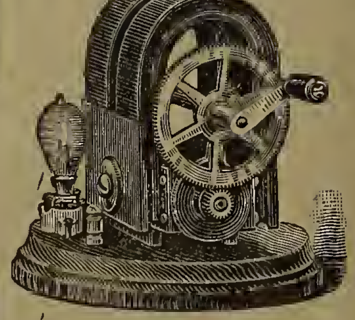

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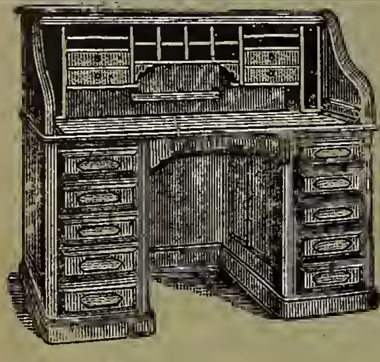

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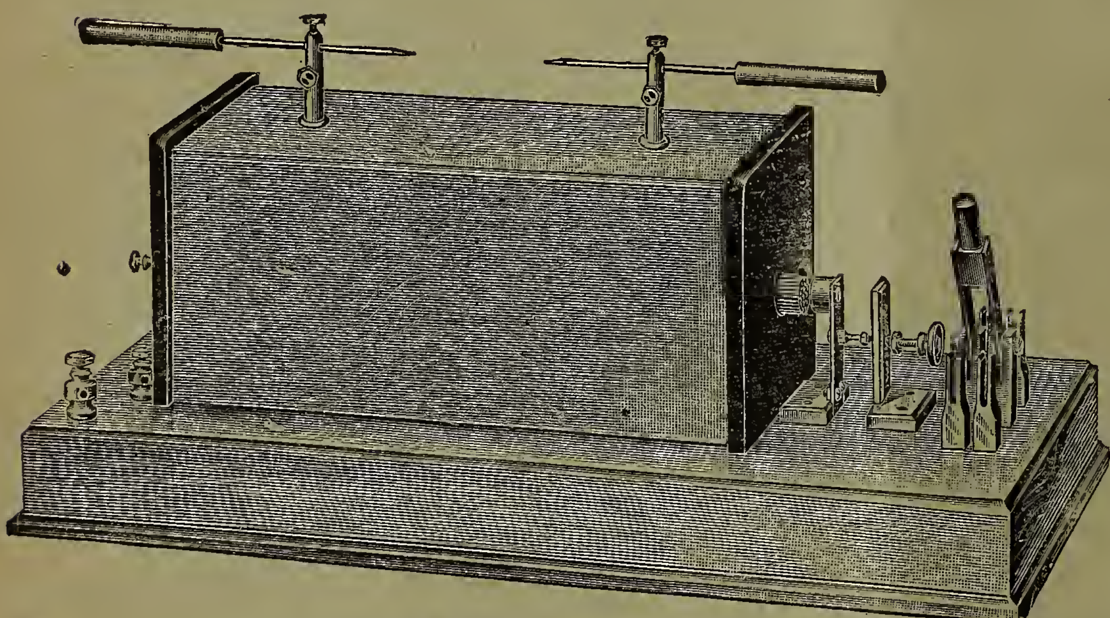

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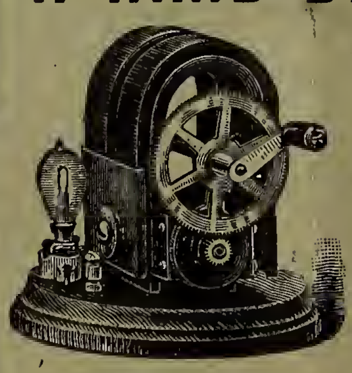

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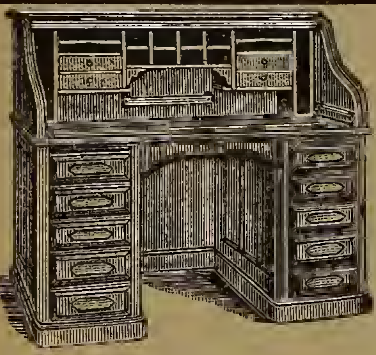

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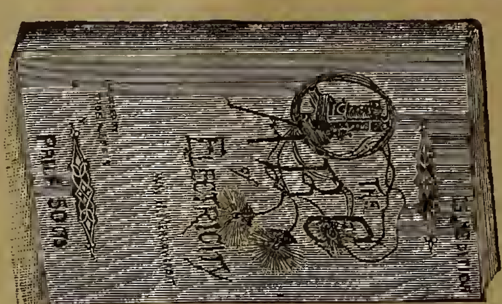

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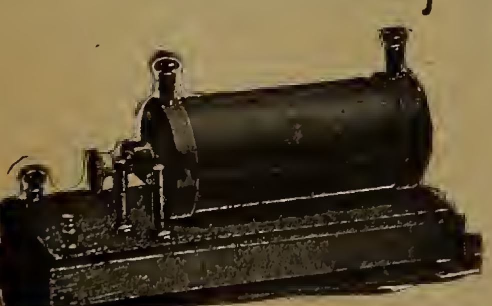

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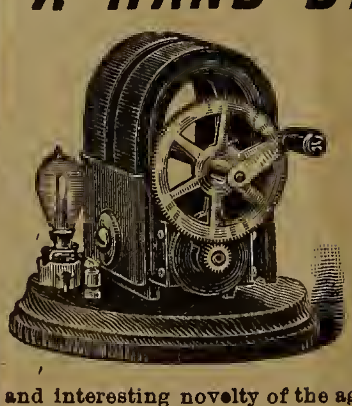

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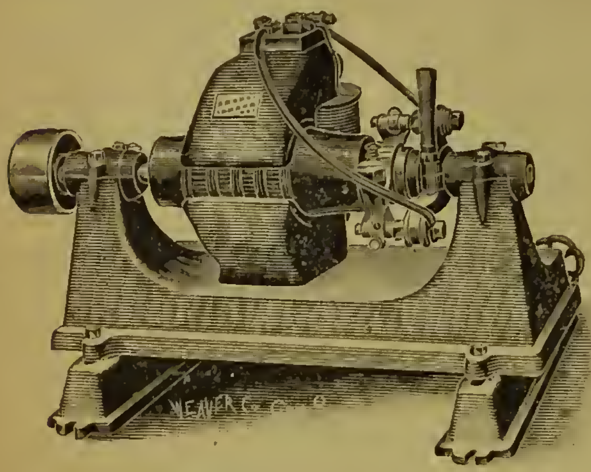

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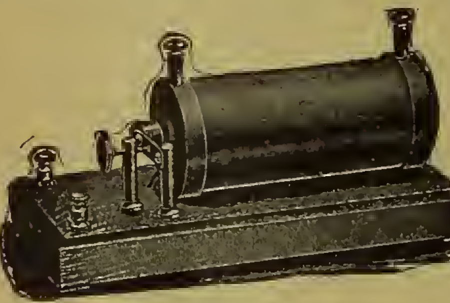

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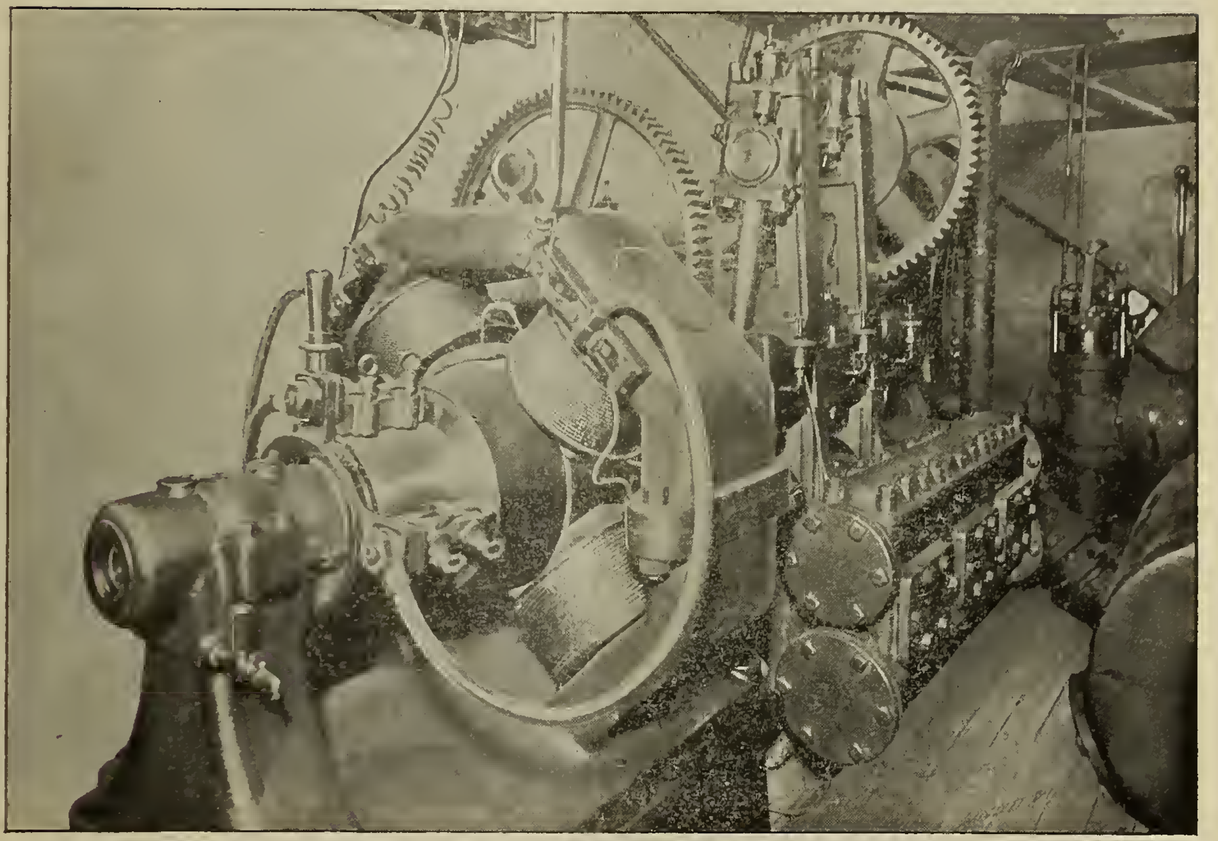
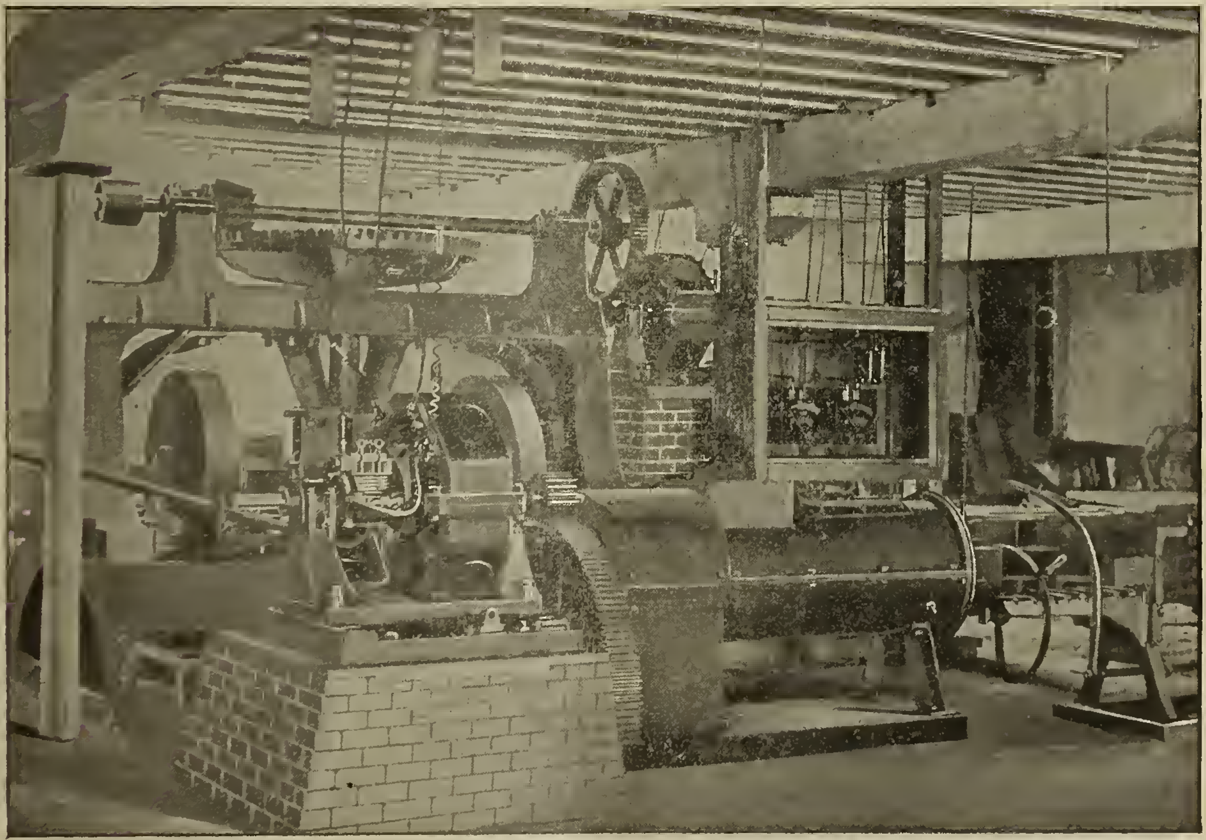


25 H.-P. Motor Used at the Granite Steel Co., of East St. Louis, Mo.



Motors for Driving Brick Machinery, Works of the Lehigh Fire Brick Co., Catesauqua, Pa.

INTERESTING APPLICATION OF ELECTRICAL MACHINERY.

Many new applications are being made of electrical machinery that have provided new fields for the inventor, better investments for the capitalist, and steadier labor for the workman.

In all the hurry of busy city life, the mechanism of its busiest centres whirls with a whirr and buzz that renders its presence lifelike and an element almost organic in its nature. The most interesting applications of special appliances is shown in the accompanying illustrations.

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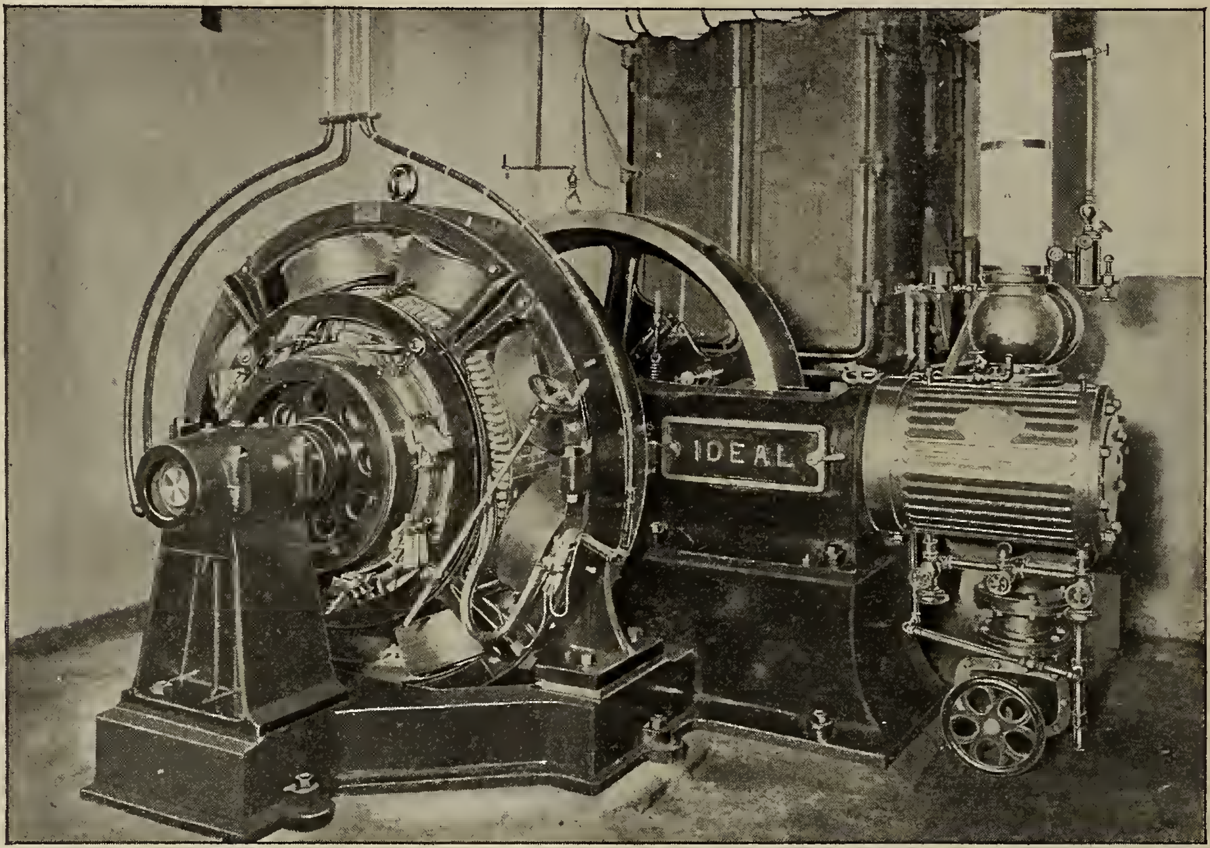
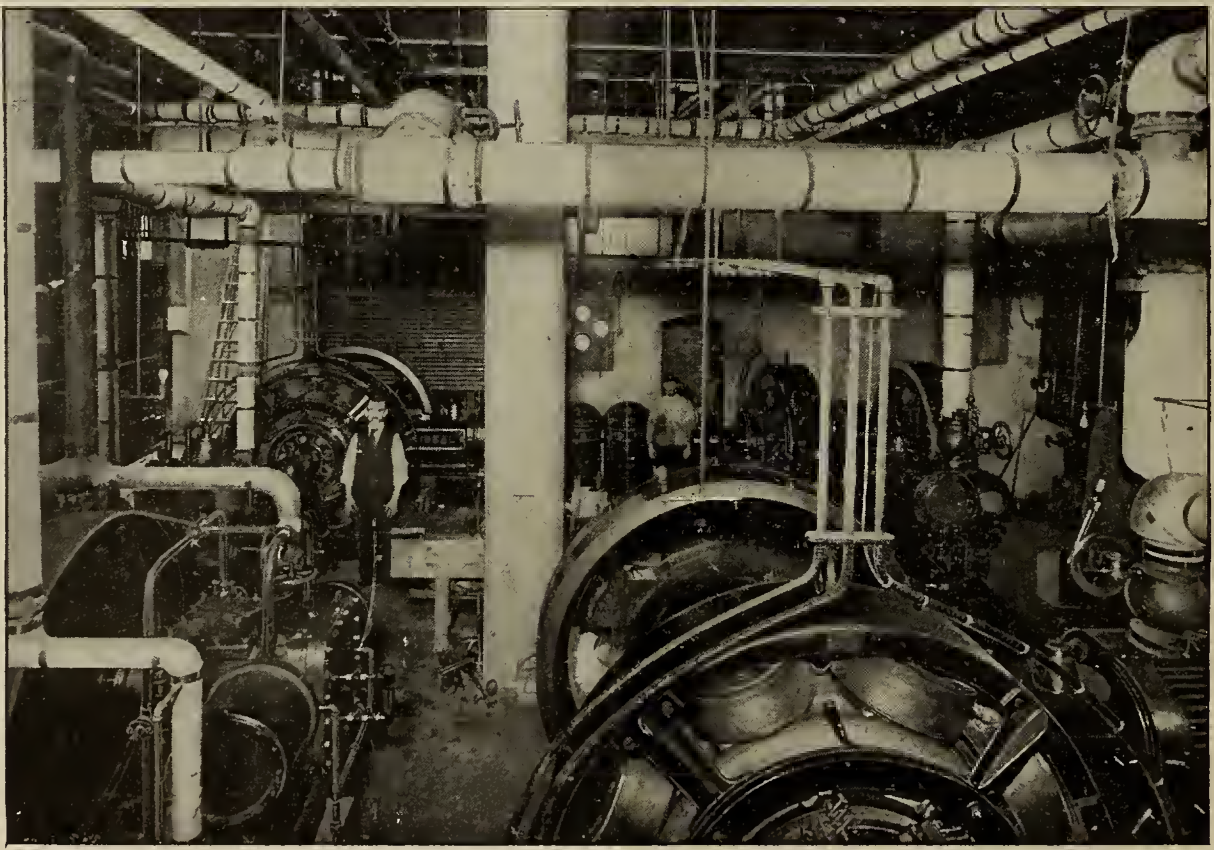
The Hotel Walton, in Philadelpnia, has had installed in it a beautiful plant consisting of three 100-kilowatt direct-connected generators and three Ideal engines.

The advance that has so recently been made in the construction and economical working of high speed engines and dynamos makes their present excellence a high tribute to the ingenuity and perseverance of American manufacturers.



One of the 100-K.W. Generators and Ideal Engines of the Walton Hotel Plant.

The present system of using "boosters" or "rotary transformers," has benefited the station to an enormous extent. The illustration gives a view of a C. & W. booster, consisting practically of a motor and dynamo direct-connected. Boosters are made by the Crocker & Wheeler Co. as large as 80 kilowatts. They are used in transforming the 500 volts of street railway circuits down to 110 volts for lighting. The Pacific Coast Jockey Club of San Francisco uses a system similar to the above.



Plant Installed in Hotel Walton, Philadelphia.

One cut gives a view of a C. & W. generator and Ideal engine; the other, of the entire plant. The smoothness and quietness of this plant places it unquestionably among the best in the country. Mr. H. S. Smith, an eleetrical contractor of Philadelphia, had charge of the installation and performed his work with the utmost credit and dispatch.

For station work they are very convenient in keeping the pressure up to its normal value, saving considerable copper and difficult regulation.

In addition to the last-mentioned uses which have in-

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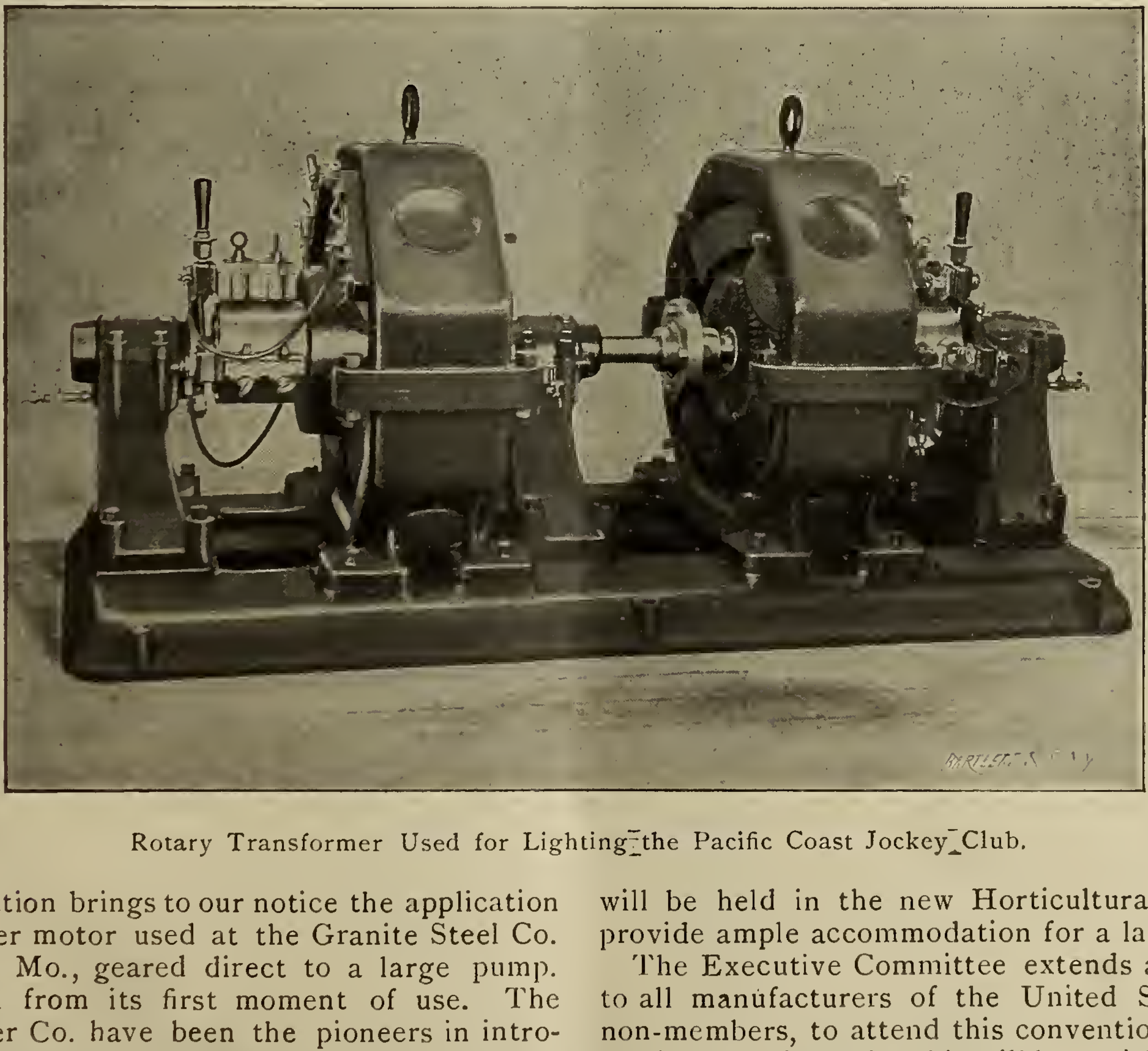

Rotary Transformer Used for Lighting the Pacific Coast Jockey Club.

The last illustration brings to our notice the application of a 25 horse-power motor used at the Granite Steel Co. of East St. Louis, Mo., geared direct to a large pump. Its success dated from its first moment of use. The Crocker & Wheeler Co. have been the pioneers in introducing electrical machinery in places and under conditions hitherto unthought of. A myriad of cases daily arise where the opportunity is ripe for the introduction of some form of new electrical contrivance. The discerning eye that sees the advantages of its immediate introduction has but to scan the future to judge of the value of priority as an element of greatest success.

NATIONAL ASSOCIATION OF MANUFACTURERS

GENTLEMEN : — The Executive Committee of the National Association of Manufacturers met in Philadelphia on December 18. Their proceedings were preparatory to the annual convention which will occur in Philadelphia on January 26, 27, and 28, 1897. The convention will be held in the new Horticultural Hall, which will provide ample accommodation for a large assembly.

The Executive Committee extends a cordial invitation to all manufacturers of the United States, members or non-members, to attend this convention. Those holding certificates of membership will be entitled to the privileges of debate and voting.

Another important matter dealt with by the Executive

Committee was the adoption of the following resolutions:

"Resolved: That it is the sense of this Executive Committee that the tariff laws should be revised at the earliest possible moment, in order that uncertainty be removed, confidence restored and business permitted to revive.

That rates of duties should be made as low as possible, consistent with the fair protection of our industries and the labor they employ."

During the convention a number of interesting addresses will be delivered by men of high standing.

The Executive Committee holds in high appreciation the friendly offices of the press throughout the country, and extends a cordial invitation to its representatives to be present at the convention. Very truly yours,

E. P. Wilson, Secretary.

SOME ACCOUNT OF THE EVOLUTION OF THE INDUCTOR ALTERNATOR.

(Concluded from Page 767.)

Figures 26 and 27 show clearly the construction of

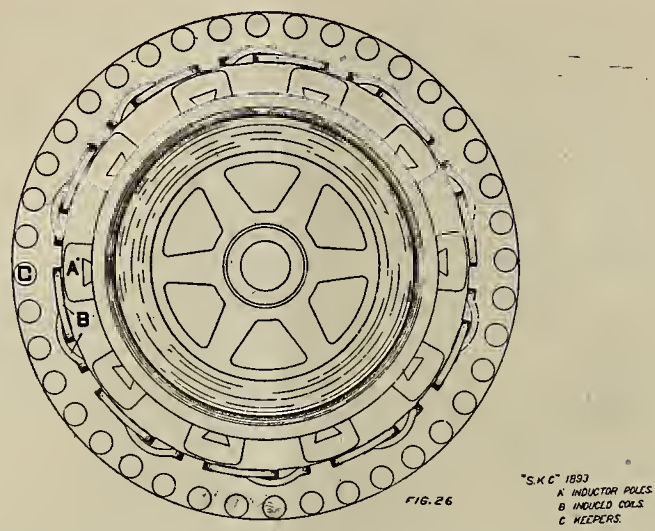

FIG. 26

the machine. The rotary inductor is a cylindrical steel casting with outwardly projecting, laminated pole-pieces at either end. The armature consists of two rings con-

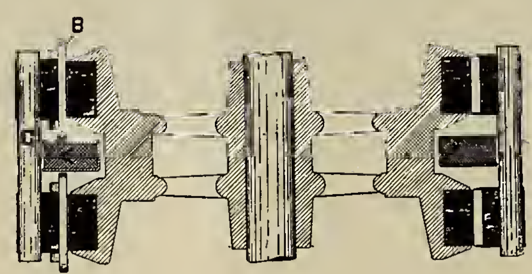

Fig. 27.

nected by wrought-iron tie bars. The induced coils are sunk below the surface in grooves in the armature rings, and the stationary exciting coil lies in the space between

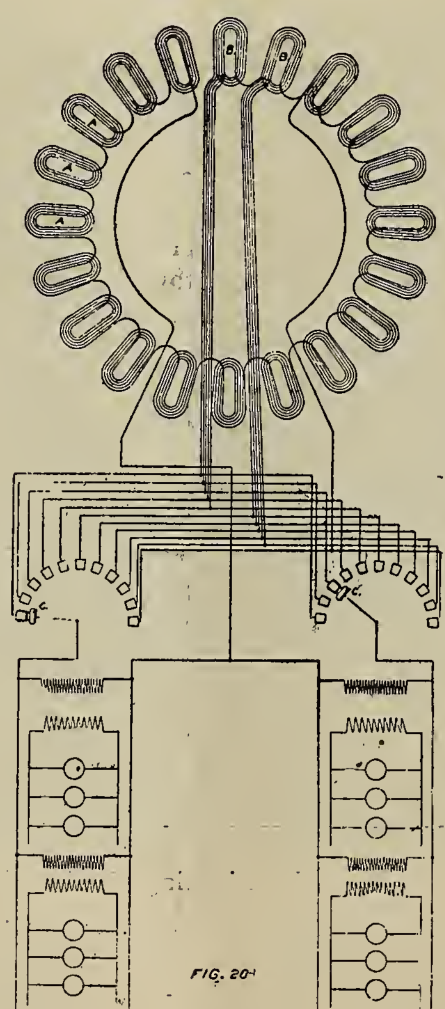

FIG. 28

the pole-pieces and the armature rings. The machine is very effectively ventilated by means of openings in the middle of the inductor under the exciting coil and the spaces between the tie bars. The exciting coil itself is

protected from injury by a massive hollow ring of cast copper, inside which it is wound.

I have already called attention to the importance of keeping the flux constant in the inductor, so as to avoid hysteresis and Foucault-current losses therein. The only thing tending to disturb the inductor flux is the varying reluctance caused by change in the relative position of the armature slots and the inductor poles. To keep this at a minimum is the chief reason for preferring a double wreath of induced coils to a single one. Mechanical interruption at both ends is necessary in either case, and it is wise to take advantage of it in distributing the induced coils. With the same amount of wire, the space variation of reluctance is much less when both air-gaps are utilized than when only one is, and, at the same time, the regulation of the machine is better. As complete lamination of the body of the inductor is difficult, even a slight change of flux is to be sedulously avoided. Lamination of the pole-pieces is necessary, even with the constant flux, as the slots necessarily change its distribution.

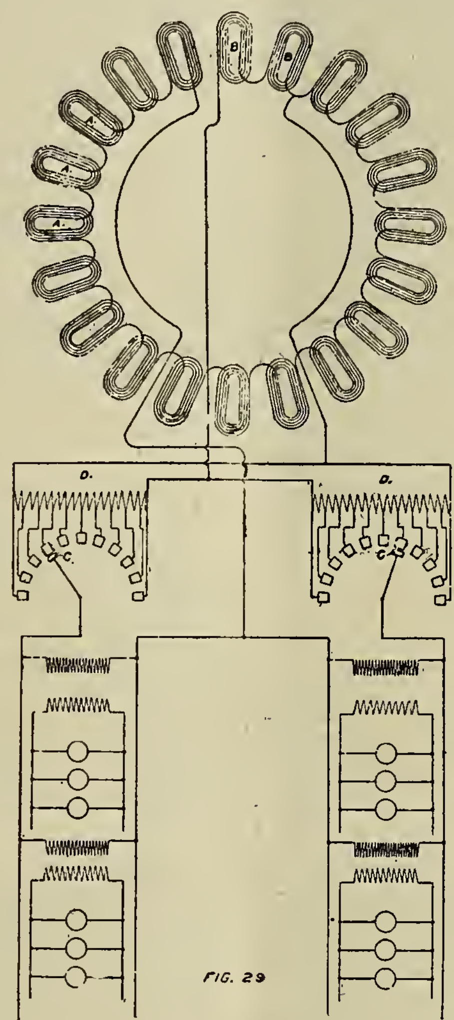

FIG. 29

But, even with the flux through the inductor constant, the difficulties are by no means surmounted. A large mass of iron in the armature is a necessity of the construction, and the losses in this way may be such as to make the machines practically inoperative. Only thorough lamination would put an end to the Foucault losses, and thorough lamination is, for structural reasons, out of the question. Another solution is imposed. Now, when the flux is constant in the inductor, it is obvious that in amount it must also be constant in the armature. It but shifts in position without altering in magnitude. But to give rise to the electromotive force in the induced coils, it is unnecessary that the shift should take place throughout the mass of the armature. It is necessary only that the shift should take place through the coils; that is, to the depth to which the coils are embedded. The problem is, therefore, to combine a steady flux in the centre of the armature with a shifting flux in the armature faces; or, in other words, the distribution of the flux in the middle of the armature must be independent of the points in the faces at which the flux enters. Stated in this way, an anology with the conditions of electrical distribution in parallel is suggested and this points to the solution. Consider for a moment two laminated rings as electrical mains and the tie bars as translating devices. Then, if the two mains be of low and the translating devices of high resistance, the current through the translating devices will be substantially independent of the points of attachment of the feeders—the analogues of the inductor poles. Similarly, if the reluctance in the direction of the lamination be low in comparison with that in the direction of the tie bars, the magnetic flux in each bar will be constant, no matter what the position of the inductor poles. In this manner, the change of flux is confined to a small portion of the armature iron, which may be thoroughly laminated, and thus Foucault-current losses are suppressed and hysteresis losses reduced to a minimum. It thus becomes possible to use in the armature any quantity and form of iron demanded for structural reasons.

It will be noticed that the inductor poles are curved in a special manner. This is done to make the electromotive force curve as nearly as possible a sine curve. You will remember that some time ago much space was given up in the electrical journals to a controversy as to the best form of electromotive force wave. Nearly every form of wave found some advocate for some purpose, but somehow the sine wave seemed always to be second-best. As we are building machines for general service, we are entirely satisfied with that curve which is second-best for each special purpose, believing it to be in consequence the best for general distribution work.

The heavy copper bobbin surrounding the exciting coil, besides being a mechanical protection for the coil, is also of use in that it prevents the development of an excessive electromotive force in either exciting or induced coils, if the exciting circuit should be accidentally broken. It resists very powerfully any sudden change of flux.

An important advantage of all stationary induced-coil machines, and, of course, therefore, of inductors, is the possibility of regulating separate circuits or feeders with little or no auxiliary apparatus. Since it is possible to tap the armature coils at any point, any desired electromotive force between zero and the maximum may be obtained for one circuit without altering the excitation, and, consequently, without interfering with the electromotive

force of any other circuit. Circuits or feeders having different drops may thus be provided for. Figures 28 and 29 show two methods of operation. The coils AA in the first are the main inducing coils, giving the electromotive force necessary for all circuits or for the mains in a feeder and main system. BB are the auxiliary or regulating coils. The number of regulating coils in circuit is controlled by the switches CC. The diagram shows only two circuits; but, of course, any number may be branched on, each with its own regulation switch. This method is the simpler for the operation of only one or two machines. With a larger number of machines I would recommend the method shown in Figure 29, as it gives simpler switch connections. In this method, the auxiliary induced coils do not act directly upon the circuits, but only through the intermediary of the auto-converters D. This method of regulation has the advantage over the ordinary "booster" system that the auto-converter D has, for the same regulation needs to be only one-half the size of the corresponding "booster," and it is, besides, more efficient. The adoption of either method secures the same flexibility and ease of control of the individual circuits as if a separate machine were used to feed each one, while, at the same time, we get the lower first cost and greater economy of operation of large machines.

HEART BEATS MADE VISIBLE.

The daily papers are becoming the most eager recipients for scientific news. They evaluate at once the commercial importance of an invention and help the experimenter along in the most friendly manner. As an illustration of this fact, the "Detroit Free Press" publishes the following news:

"A most extraordinary series of experiments were tried last evening and tonight at the physical laboratory of the University of Michigan, under the direction of Prof. H. S. Carhart, assisted by Dean V. C. Vaughn, of the medical department, and Drs. W. J. Herdman and F. G. Novy. By means of skilfully contrived apparatus these gentlemen and a few invited guests were able to see the heart pulsations of a living man and watch the play of the bones in various parts of the body when in motion. It was a marvellous sight, and one that inspired the less scientific beholders with profound awe. When the guests entered the room in which the experiments were to be tried there was nothing in sight but a lot of familiar electrical apparatus. A new induction coil stood on a table. Four cells of a storage battery stood under the table. A resistance coil stood alongside. A few scraps of insulated wire, a pair of Crookes tubes and a curious-looking box completed the equipment. It was soon explained that this box was the important element in the experiment. The spectator was to glue his eyes to the opening at the small end and look hard at the black pasteboard in front of him. The room was then darkened and the battery turned on, a new Crookes tube of great power being put in the circuit. As soon as the box was turned toward the tube the inky darkness of the interior of the box disappeared and the black pasteboard became grayish-white, like a pane of ground glass. Prof. Carhart then thrust his hand between the tube, now brilliant with the peculiar greenish phosphorescent light that accompanies the production of the X rays, and every bone became distinctly visible on the pasteboard screen, surrounded by a cloudy outline showing the limits of the fleshy covering. The X-ray photograph is shadowy, vague and unsatisfactory, compared to the results obtained in this new manner. The thinnest gauze more obscures an object to the eye in sunlight than did the covering of skin and muscle obscure the bones in Prof. Carhart's hand. Then his wrist was put in, and his arm to the shoulder. The wrist was turned, the elbow flexed and straightened, and the arm twisted back and forth. It was like watching a skeleton in a slight haze, mysteriously endowed with the power of self-motion. The clothing was no hindrance to the vision, the rays passing through clothing as readily as the naked flesh. Then Dr. Novy tried a few objects in the field, and finally sat before the tube and allowed the spectators to count his ribs, and suddenly it was discovered that the heart was visible, and that its pulsations could be watched and counted. The heart was misty in outline, not distinct like the bones; but there it was, moving regularly, and the spectator counted its pulsations while Dr. Herdman stood with his finger on Dr. Novy's pulse to verify the count, and make sure it was not the flickering of the light that misled the eye. The inside of the screen to the curious box was covered with a layer of tungstate of calcium, by means of which layer the X rays were transferred into rays of light that affect the eye, thus making the X ray visible. An effort will be made after a while to fix a large screen in a doorway, so that all of an audience in a dark room can see the pictures simultaneously, the room supplanting the box. In this way the whole skeleton of a man may perhaps be shown at once, and at the same time walking about."

NOTES WORTH NOTING.

Santa Clara Lights Itself.—The town of Santa Clara, Cal., is now lighted by its own electric lighting plant. The system was put into operation December 3, and for the first time in three months the streets were lighted. The plant was erected at a cost of about $10,000, and is operated in connection with the town's water-works, which was completed about a year ago at a cost of $50,000. The streets are lighted with forty-two arc lamps.

Tupelo-Jackson Telephone Line.—The Tupelo Journal says the promoters of the telephone line from Tupelo, Miss., to Jackson, Tenn., were in Tupelo a few days ago, and gave assurances that the line was being rapidly pushed and would be completed in a short time. They were in Tupelo for the purpose of arranging for an entrance into that town.

Wenstrom Electric Company.—The annual meeting for the stockholders of the Wenstrom Electric Company was held at Hotel Rennert. The board of directors for the ensuing year were elected as follows: Messrs. G. M. Hutton, James A. Gary, Ferdinand C. Latrobe, Robert Rennert, Seymour Mandlebaum, Peter E. Tome and H. Marcus Dennison.

J. N. V. Lane, the electrician, this city, has just completed equipping the Hathorn Manufacturing Company's new establishment in Brewer with a 350-electric-light plant and has commenced to install a 300-electric-light plant into the big lumber mill built at Ashland in Aroostook County by the Ashland Manufacturing Company.

Tacoma.—The board of public works announces that the new 1,000-lamp dynamo loaned to the city by the General Electric Company until the 2,000-lamp machine arrives, is now in place and the city is now in a position, the board says, to furnish more incandescent lamp-lighting.

Trolley and Battery Combined.—Electric street cars in Berlin, Germany, will be propelled by means of storage batteries in the central part of the city, while trolley lines, with overhead conductors, will be used in the outskirts of the capital.

Chicago's Electric Bridges.—Electric power for draw-bridges is to be adopted for all the bridges over the Chicago River at Chicago, Ill., replacing the steam plants now required for each bridge.

Biloxi, Miss.—John Carraway, Biloxi, Miss., wants to correspond with makers of telephone equipments.

The Electrical Age.

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CONTENTS.

ELECTRICITY AND PINTSCH GAS.

The elevated roads in this city have decided to adopt Pintsch gas in their cars.

The expense of installing a Pintsch system of lighting is such that we are surprised at the conclusions reached on the subject. The Brooklyn Bridge officials were offered a Pintsch system of gas lighting, but refused to have anything to do with it. An eminent authority from Brooklyn states that the comparative figures regarding the cost and expense of maintaining either gas or electric systems is as follows:

Pintsch gas installment offered the Brooklyn Bridge,	$32,000
Maintenance,	11,000
Electric light plant for same,	9,000
Maintenance,	1,800

The reader can judge of the convenience and merits of each system from a standpoint that is entirely distinct from commercial considerations, and only based upon the personal satisfaction derived from the use of each.

There is, of course, something self-contained about the use of gas tanks that is most inviting to the mechanical engineer. But no doubt at present exists as to the feasibility and practicability of lighting and heating cars by electricity. It is therefore strange that a trial was not made by which the qualifications and cost of each could be ascertained.

It is not a difficult matter to predict the future popularity of electricity in car lighting, that its introduction will be wide-spread, even in those cases where a most conservative attitude is displayed towards it.

THE MUNICIPAL OWNERSHIP OF PLANTS.

There is every reason to suppose that in the course of time the ownership of plants for municipal lighting will be a matter of past comment. It has been claimed by some that the control of such institutions by the city would retard the proper development of the art; that improvements either in apparatus or methods are due to a competition that would in such a case cease to exist. Whether the truth of such opinions would be borne out, or not, time and experience only would demonstrate. But the control within itself of so necessary a part of a city's equipment seems to be naturally in line with its postal service, street cleaning and other city departments.

If the problem of the municipal ownership of plants is to be considered, even without analysis, the conclusion reached would be that such a change is only beneficial if it offers inducements to the customer or consumer of power, that is, the city itself—if the expense is less and the convenience greater; if the chances of progressive development exist in an undiminished degree. The advocates of this future change claim that the city has no right to use its taxpayers' money through a middleman, when it has the right and possesses the capacity of acting otherwise; that great sums are frittered away because of the sluggish insight of municipal officers, and that economical changes might result of direct benefit to the people which would invite either more service for the same money or the same service for less money.

The expense involved in an electric light plant is a feature of considerable prominence at present. Competing companies have forced each other down to the very lowest pitch in price. The responsibility of supplying light is upon other shoulders, and the payment for such dependent upon the uniform satisfaction its use engenders. The city is excempt from the local storm of office-seekers in this quarter and the ever-present chance of so important a department being controlled by an incompetent political agitator. The commonly prevalent idea regarding the wealth of electric light companies is similar to that held in relation to railway corporations. They are not able at present to acquire even an aldermanic prosperity, because, instead of being the recipients of a largess, they are today unfortunately systematic disbursers. Continual investments are forced from them for new lines and improvements, and to a great extent their sorrowfully relinquished profit finds its way entirely into the ground. The particular department of city lighting is a stand-by that shelters them from financial adversity. It is questionable, therefore, whether the sum paid out for public illumination would be better spent if it were part of the expenditures required for a municipal plant with its attendant troubles of management and repair.

A FIFTEENTH ANNIVERSARY.

We call the attention of our friends and readers to the fact that this coming January 2 completes the fifteenth year of our existence in the field of electrical journalism.

Beaumont, Tex.—The contract for the construction of the East Texas Telephone Co.'s line from Beaumont to Sabine Pass, Port Arthur and Orange, a distance of about sixty miles, has been let.

Norfolk, Va.—The Citizen's Bank will construct a nine-story building with steel interior architectural work, three elevators, steam heat, electric light, etc. An electric light plant and a steam-engine will be required; no contracts let; estimated cost, $100,000; architect's address, Charles E. Cassell, 401 Law Building, Baltimore, Md.

Polyphase Electric Currents. The Third Volume of the Set,

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11. Measurement of Polyphase Powers
12. Notes on Design of Polyphase Motors
13. Mechanical Performance of Polyphase Motors
14. Some Examples of Modern Polyphase Motors

CHAP.
15. Distribution of Polyphase Currents

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II. Schedule of British Patents on Polyphase Motors

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Plate II. Three-phase One Horse Power Motor

These famous works are the authorities on the subjects. They are used in Harvard College, Boston School of Technology, Drexel Institute, Philadelphia; Stevens Institute, Case School of Applied Science, Cleveland, and in fact in all the Colleges and Schools throug out the world where they have Departments of Electrical Engineering.

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THE MEASUREMENT OF CURRENT.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

In order that currents may be measured with accuracy, either for purposes of comparison or direct use, certain methods must be adopted which may be generally classed under the following headings :

(a) Electro-Chemical, { Volume Voltameter / Metal "
(b) Electro-Thermal,
(c) Electro-Magnetic.

The electro-chemical, as defined by its title, is one closely allied to certain chemical reactions produced by the passage of a current through a solution. It is therefore possible to review the means by which a current passing through an electrolyte, either of metallic salts or water, produces effects of a reliable and visible nature capable of immediate measurement.

The electro-chemical method calls into use a simple form of instrument called a voltameter.

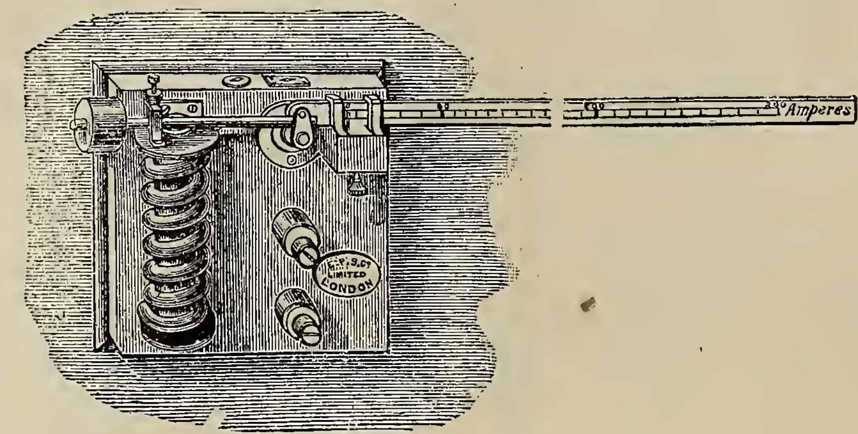
Voltameters, while serving the same purpose in this case, are divided into two kinds—the *volume voltameter* and the *metal voltameter*.

A *volume voltameter* consists of a glass vessel containing a conducting liquid in which is immersed two narrow plates of platinum called electrodes. Upon passing a current through this instrument, the liquid (a weak solution of sulphuric acid), becomes decomposed and a mixed gas is evolved, composed of oxygen and hydrogen. The greater the current applied to the voltameter the more rapidly is the gaseous mixture set free. Each unit of current is capable of producing equal quantities of oxygen and hydrogen, or equal volumes of gas are produced by equal currents flowing for an equal time. Thus it may be proven that *the strength of the current is proportional to the number of cubic inches of gas developed in one minute.* If by previous experiments the volume of gas set free from water undergoing electrolysis be ascertained, the strength of current corresponding to a given volume of gas may be used for all future experiments. A volume voltameter may be constructed by means of two copper plates, a glass jar and a deep basin.

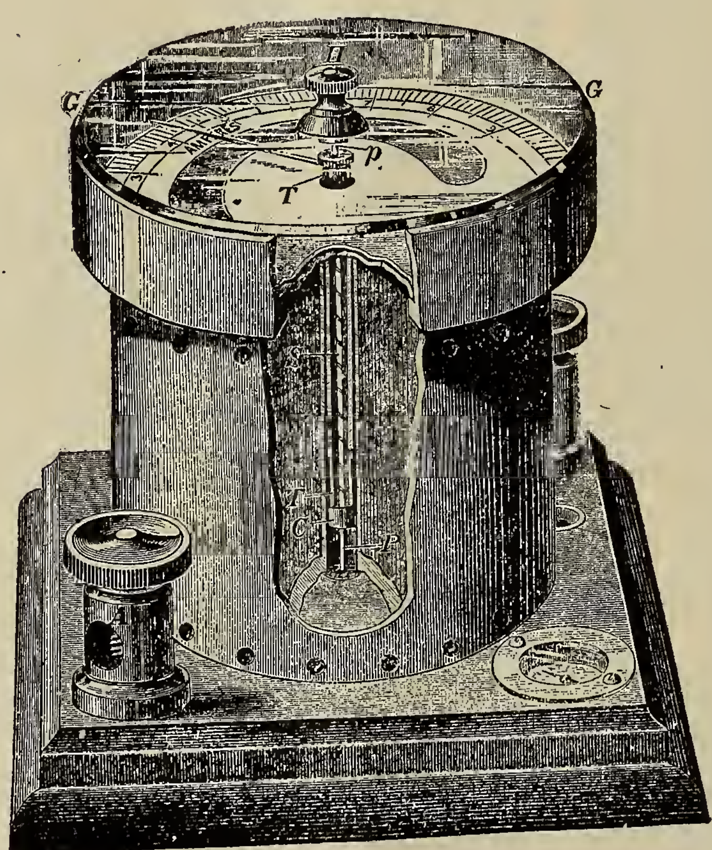
The number of cubic inches or cubic centimeters of the jar must be determined. A scale is affixed to the side of the jar denoting this capacity in graduated steps with the zero mark at the bottom of the jar. A wide cork or cover is placed over the jar containing a tube and the two electrodes. If the jar be filled with acidulated water and inverted into the half-filled basin, the jar will remain full; but when the two electrodes are attached to a source of current, decomposition ensues and the gas forces the water out.

The number of cubic inches or centimeters of gas remaining between the level of the water and the bottom of the jar can be at once determined.

A *metal voltameter* consists of two electrodes dipping into a solution of metallic salts. If the electrodes or plates are of copper, a solution of copper sulphate will be most

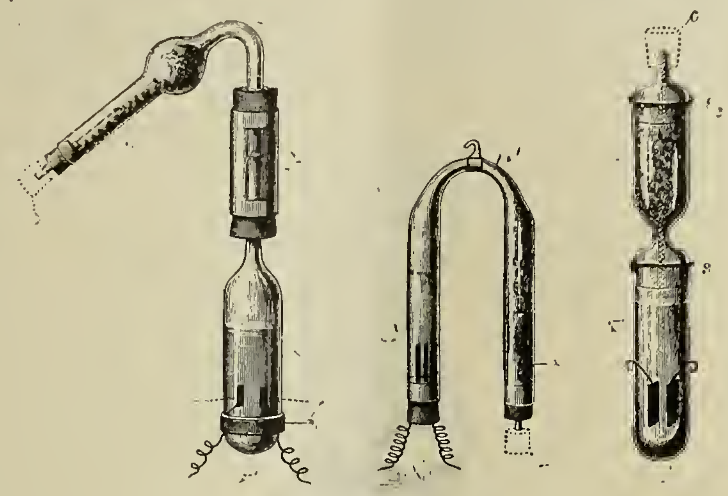


Steel Yard Dynamometer.



Hot Wire Ammeter.

satisfactory. Upon passing a current between the two electrodes, pure copper is deposited upon the negative electrode. If the negative plate is weighed before and after the experiment, and the time in minutes and seconds carefully noted, the amount of copper deposited each second or minute is quickly determined in grams.

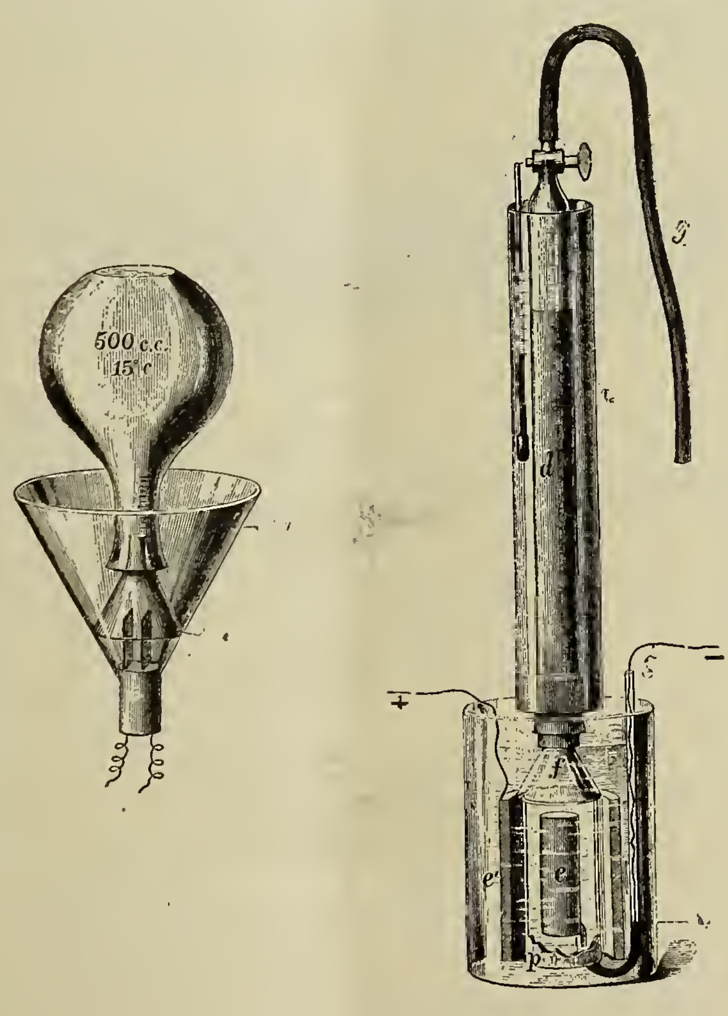


Metal Voltameter.

A repetition of this experiment will prove that equal currents always deposit equal weights of the same metal. The current flowing between the plates can be computed by calculating the weight of the metal, in grams, deposited per second.

One ampere deposits 0.32709 milligramme per second; therefore, knowing the weight actually deposited, the true current in amperes is obtained by division.

A coulomb being equal to an ampere flowing for one second, the above method calls for the number of coulombs per second.



Volume Voltameter.

Electro-Thermal.—If the extent to which a metallic wire stretches when heated be determined by experiment, the term "coefficient of expansion" clearly defines such an effect, if referred to as the increase in length per foot, or even the percentage of increase over all.

A current passing through a wire heats it, although not in *direct* proportion to the current. If the current is one ampere and the heat be measured, by increasing the current to two amperes the heat becomes four times as great. This is due to the fact that the heat does not depend directly upon the current, but upon C × C, or the square of the current. With a current of three amperes the heat becomes 3 × 3, or nine times as great, etc.

If a wire carrying a current exercise its expansion or contraction upon a hand or pointer placed before a dial, the wire passing over a little wheel attached to it, and a spiral spring hold the pointer at zero when no current passes, the wire would expand when the current flowed through, the spring would gather in the slack wire, and by doing so move the pointer, thus indicating a current. The elements of an electro-thermal instrument are contained in this illustration.

Prof. Forbes, of England, invented an electro-thermal instrument in which a coil of high-resistance metal being heated by the passage of a current caused a small windmill with mica blades to rotate.

The current would affect the velocity of the prime mover by the least variation, but its extreme delicacy forbade its use as a practical instrument. This instrument might more properly be classed under the head of recording ammeters, as that was its evident object. There are other types of instruments which record both current and pressure, but the principle of their action is not thermal, and they cannot be included here. Hot-wire instruments or their equivalent have fallen into disuse of late, because of

the greater accuracy and more attainable perfection of electro-magnetic devices.

Electro-Magnetic. — Electro-magnetic instruments depend for their current-measuring properties upon the relation existing between a current and the magnetic effects that follow from it. Although the methods of measurement employed under this head are very numerous, the means by which effects are produced may be briefly stated:

(1) A coil carrying a current affects a movable magnet.
(2) A magnet affects a movable coil.
(3) A coil affects a movable coil.

Practically all the devices of the above order, with the exception of the last, might be termed galvanometers.

For the absolute measurement of current the galvanometers of the following order come into prominence; they belong to the first order:

A stationary coil and a movable magnetic needle:

(*a*) Tangent galvanometer.
(*b*) Sine galvanometer.

A most unique type belonging to the second class was invented by M. D'Arsonval, with an immovable magnet and a movable coil. The famous Weston instruments act on the basis of this principle.

Under the head of the third class—a stationary coil actuating a movable coil—both of the following are practically dynamometers:

(*c*) Dynamometer.
(*d*) Ampere balance.

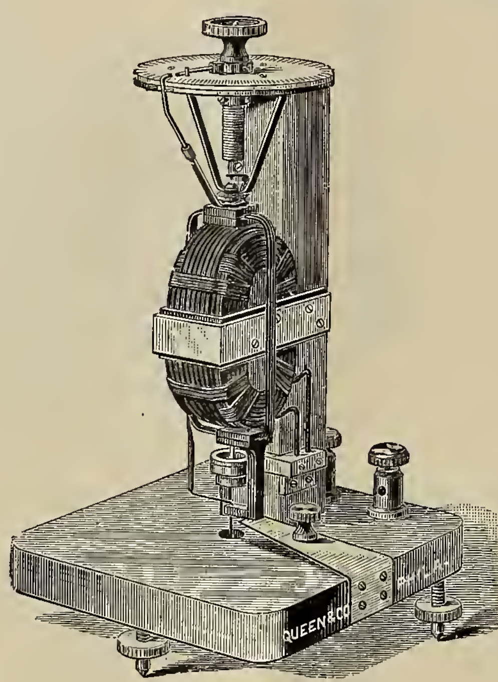
An intermediate and very common form of current indicator consists of a coil whose entire function is the attraction of a soft iron core. As the extent of the attraction depends upon the current, the movement of the core after the proper attachment to a pointer has been made may be marked on a dial and thus used for future reference.

The process of calibration is adopted with such devices, that is to say, the use of currents whose strength is varied and successive values known and recorded on the hitherto unmarked dial. The Edison Company employed this form of instrument, which is generally known as the Bergmann ammeter.

The *tangent galvanometer* is composed of a coil of large diameter, more aptly designated as a narrow reel. At the centre is a pivoted magnetic needle above a circular dial marked in degrees. The currents passed into the instrument cause different angular deflections. The currents are not proportional to the angles themselves, because by doubling the current the deflection is not increased twice. The currents, however, are proportional to the tangents of the angles. Triple the current will swing the needle around to an angle whose tangent is three times that of the previous angle. A value termed the constant of the galvanometer is found and the current calculated by the rule—

current = constant × tangent of angle of deflection.

The constant is obtained by sending in a known current —observing the deflection—and its tangent is obtained.



Dynamometer.

The constant which can be used for all future cases is

$$\text{constant} = \frac{\text{current}}{\text{tangent of angle of deflection.}}$$

A *sine galvanometer* works on an equally simple principle, the current being proportional to the sine of the angle of deflection—the rule being

current = constant × sine of angle of deflection;

the constant is a quantity determined in a similar manner for practical use.

The D'Arsonval galvanometer has a permanent steel magnet with a coil suspended between its poles. A metal cylinder upon which the wire is wound gives to this instrument the peculiar and useful property of being *dead beat.*

The Weston ampere-meter, or ammeter as it is commonly called, with some slight changes is identical with the above. The coil in this instrument is suspended on pivots. A pair of watch-springs convey current to the coil and bring it back to zero when it ceases.

The springs do not lose their temper, because the entire current passes freely on through the instrument, while a slight portion required for the movement of the coil is shunted into it. The instrument is calibrated by passing known currents into it and the deflections marked on the dial. They are equal, and in ammeters of this particular construction accurate to within $\frac{1}{10}$ of one per cent. The springs unwind as the deflection increases and thus serve in part to equalize the deflections.

Dynamometers record readings which are proportional to the square of the current. A fixed coil is so situated that a coil in the same plane, both being of rectangular shape, is inclined by the effect of the current; the movement of the inner coil acts upon a wire by which it is suspended and also moves the hand of a dial. To bring the coil back to its former position requires a twisting or torsional force, which must be applied to the wire. The current is proportional to the square root of this angle of torsion.

The ampere balance, invented by Sir Wm. Thomson (Lord Kelvin), depends upon a very simple principle for its action.

A pair of coils are placed side by side and another pair

placed above, but balanced like a pair of scale pans on two fulcrums, both being connected rigidly by a bar or pair of bars. The repulsion and attraction are compensated for by weights, which increase the range of the instrument or diminish it. The weights are slid along an arm and thus bring about a balance. The coils are calibrated so as to give a variety of readings, dependent upon the weights, and the extent of correct readings runs into hundreds of amperes. Its great advantage lies in the fact that it can be used equally as well for alternating currents.

Ampere meters are of a variety of shapes as well as kinds, but the majority work on an exceedingly simple principle, as previously described.

Recording ammeters of a somewhat expensive pattern have been produced by various inventors, but today it can hardly be said that there is really a single moderately cheap form of recording ammeter on the market. The Edison Illuminating Co. still adhere to the electro-chemical method in their meters, and the prevalent types of ammeters that are called recording have failed to appeal to them. The hot wire mica-vane instrument of Forbes and possibly a system of photographing a moving spot of light reflected from a mirror, employed by the Walker Co., are the few that utilize complex methods for that purpose.

A famous inventor and scientist suggested the use of a wheel of copper, immersed in a copper sulphate solution, for the purpose just described. The copper wheel being gradually loaded on one side with copper that has been plated on it would slowly rotate, and thus record the current consumed in the circuit. While the idea is ingenious, the practical development of it is full of difficulties.

A simple form of ammeter of sufficient accuracy to be depended upon, and an equally simple form for the actual recording of the current, would be of value and importance to those practically interested. Were it possible to suppress other phenomena, which invariably make their appearance when a current passes in a circuit, the decomposition of water might be utilized as a possible means by using its accumulated pressure for the movement of a mechanical system, which would record the volume of gas passing.

An ampere has been defined as the current which passes through a resistance of one ohm at a pressure of one volt.

The true unit of current is based upon the absolute system of units sometimes called the C. G. S. system—the centimeter, gramme and second being the quantities involved.

If an arc of wire of one centimeter radius and one centimeter length be brought near a unit magnetic pole, if the unit pole be placed at the centre of a circle of which the wire is a part, it will be affected by the force of one dyne. A dyne is the unit of force developed by the unit of weight moving a unit of distance in a unit of time. As the units have been specified, the movement of one gramme a distance of one centimeter in one second brings into being one dyne.

The arc of wire producing such an effect will then be carrying a unit of current. This, however, is so large that the practical unit has been made one-tenth of it, and is called the ampere.

The electro-chemical method of determining the ampere has already been considered. The coulomb comes into direct consideration in this method, it being well known that the transference of a metal never varies in quantity when carried over by one coulomb. Whereas one coulomb of electricity will transfer a different weight of copper than iron, and a different weight of silver than gold, the amount of metal carried over by a coulomb for each particular metal never changes.

Certain fixed proportions always exist, and their immutability has been repeatedly tested without failure.

$$\text{For Volume Voltameter } C = \frac{v}{t \times .1734} \qquad v = \text{cu. cms.} \quad t = \text{seconds.}$$

ELECTRO-CHEMICAL EQUIVALENTS.

	Grammes per Coulomb.
Hydrogen	.00001035
Silver	.00118
Copper	.000326
Water	.00009315

GEIPEL'S PATENT STEAM TRAP.

We illustrate the Geipel steam trap, which has some features of particular interest.

The illustration shows the trap with the valve free to open and discharge. Heat expands and lengthens the brass pipe, causing the valve to rise and closing it against the lever. The reduced temperature of water contracts the tube, causing the valve to fall away from the lever allowing it to open. Thus, when there is water in the brass pipe, the valve will always be open, and when there is steam, it will always be closed. It is apparent, therefore, that the trap is capable of delivering a stream of water equal to the full bore of the pipe, if water in sufficient quantity is present to be removed.

The only working part to this trap is the valve, and that can be seen rising and falling as the trap performs its duties. By pressing down upon the lever, the resistance to the valve opening is removed and a simple means is thus afforded of blowing through when necessary.

Geipel's Patent Steam Trap.

The trap consisting only of two tubes, there is no place in which scale or dirt can lodge. It will work equally well in any position, and if placed upside down will drain entirely dry; it cannot, therefore, freeze.

This trap has been attached direct to the jackets of steam-engines and, being compact in form, it is not unsightly when placed on an engine base plate. It will remove water as rapidly as formed from any point of condensation.

It has been largely used in connection with heavy pressures, and it works equally well at a pressure of one pound per square inch.

Amongst the users abroad we note the names of Earle's Shipbuilding Co.; Palmer's Shipbuilding Co.; John Penn; Wigham, Richardson & Sons; Willans & Robinson, makers of the famous Willans engines, and many others whose names are household words in the engineering world.

The traps are not high-priced, and it would appear that there should be room for another article in this trade.

Sole manufacturers, Thorpe, Platt & Co., 97 Cedar street, New York.

Allandale, Ont.—Allandale will be lighted by the Barrie, Ont., Electric Light Company.

THE RUGGLES SNOW PLOW.

MANUFACTURED BY THE PECKHAM CO.

Show on tracks has frequently hampered the operation of street railways to an alarming extent. The clean snow insulates the car from the track and impedes progress of any description.

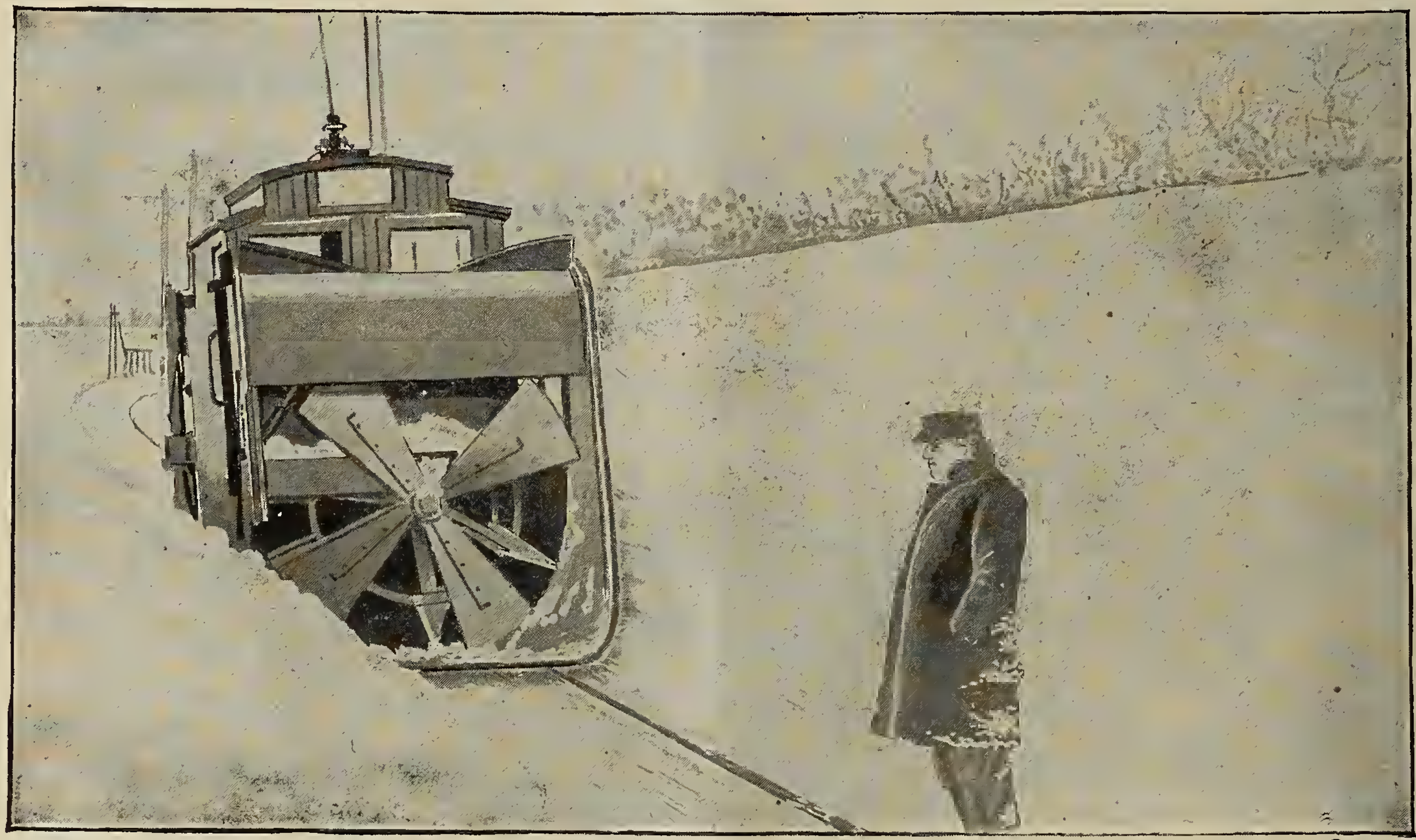
The rotary snow plow illustrated is identical with a steam rotary plow in general, except that its operation depends upon an electric current instead of steam.

We append the letters from different concerns with their opinions and sentiments on the subject, as well as their actual experience:

Buffalo, Bellevue & Lancaster Railway Co.
Superintendent's Office,
Bellevue, Erie Co., N. Y., April 15, 1896.

Capt. Geo. W. Ruggles, Charlotte, N. Y.

Dear Sir:—It is with pleasure that we tell you of the wonderful work done by the rotary track cleaner built by you, which has just been through its second winter.



The Ruggles Rotary Snow Plow.

Drifts from six to twelve feet deep are common on our lines, but the "Rotary" walked through them with ease. We wisely put the plow in the hands of two of our men who, almost unaided, kept our lines open.

As a result we were not blocked a single day and our cars are not crippled up from "bucking snow."

Very truly yours,
(Signed) Richard E. Danforth,
Superintendent.

We also refer to the Buffalo Railway Co., Buffalo, N. Y.

Rochester Electric Railway Company.
Charlotte, N. Y., April 13, 1896.

Mr. Geo. W. Ruggles, Charlotte, N. Y.

Dear Sir:—In reply to yours of the 17th, asking if I could give a testimonial in favor of the Ruggles track cleaner, would say that it gives me great pleasure to do so.

Our road is between four and five miles long, running north and south through a country where we have heavy drifts to encounter, and I know it would have been impossible to have kept the road open many days during the past winter, only for the above cleaner.

The cleaner went through drifts in many places four feet deep, leaving a clean cut and not throwing up the objectionable piles of snow on either side, which if removed in any other way were likely to tumble in again upon the track; and after having gone through once the track can be widened, which is a strong point. I confidently assert that it will do more work in an hour than fifty men with shovels in a day. No push plow or sweeper could do the work that we did with the cleaner last winter.

Four men are all that is necessary to operate the cleaner. I can assert with all truthfulness that I know of nothing that would do our work as cheaply and as well as the Ruggles track cleaner, and take pleasure in recommending it to all electric roads. Any further questions or information in relation to the working of the cleaner on this road last winter, I will cheerfully answer at any time.

Very truly yours,
(Signed) C. A. Derr, Supt.

Niagara Falls & Suspension Bridge Railway Co.
Niagara Falls, N. Y., March 31, 1896.

Geo. W. Ruggles, Esq., Charlotte, N. Y.

Dear Sir:—Referring to your letter of the 20th inst., I have no hesitation in saying that the Ruggles rotary track cleaner is the best device on the market for removing snow. I know of no other plow that can be compared with it.

We bought two of them last fall and I consider we have saved $1,000 by their use. Without them we would have been unable to keep some of our lines open. They are most economically operated, only two men being necessary for a crew. During the past winter your machines have removed snow from four inches to five feet in depth without the aid of a shovel, and one machine can remove more snow in an hour than fifty shovellers could in a day.

Yours very truly,
(Signed) J. C. Brewster, Supt.

Dynamo Electric Machinery, by S. P. Thompson, has been placed upon the book market by the American Technical Book Co. The matter inside has been carefully revised and added to, and the illustrations are particularly fine. The volumes are neatly bound and cannot be too highly recommended.

Washington, D. C.—The Metropolitan Railway Co. has decided to extend its electric line in the suburbs. Address S. L. Phillips.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—RELATIVE COST OF GAS, ELECTRICITY, ETC.

Bangor, Dec. 22, 1896.

To the Editor of Inquiry Column.

Dear Sir:—The lighting of districts has been the most interesting subject of my life. Would you kindly give me your opinion of the relative cost of lighting by gas, electricity or other illuminants? I would be under the greatest obligations to you for the same.

Yours most respectfully,
Simon R. Pring.

(A.)—Gas costs the consumer in this city $1.25 per thousand cubic feet; electricity costs one cent per ampere hour on the average. Oil is decidedly cheaper than either. The cost of producing electricity, gas, etc., is not easily given because of the difference in rent, fuel, etc., in different localities. The electric light plant must always charge enough to include the interest on its machinery and subways to make ends meet.

(Q.)—HOME LIGHTING.

Toledo, Dec. 20, 1896.

Electrical Age Pub. Co.

Dear Sirs:—In your interesting Inquiry Column I have obtained much valuable knowledge. Being earnestly desirous of putting to some practical use my electrical information, I thought it best to seek your opinion first on the matter I have in mind. Would electric lighting pay in the home on a small scale? If it were only as dear as gas I would be satisfied. Awaiting your reply, I am,

Yours truly,
A. Seymour Knowles.

(A.)—Electric lighting on a small scale pays provided a steam or oil engine is used. Gas engines are not economical, unless several horse-power is developed. House lighting with *low watt* lamps, that is, lamps using the least possible current, is likely to compare favorably with gas if about 20 or 30 lamps are run.

(Q.)—THE GENERATION OF E.M.F.

Montreal, Dec. 18, 1896.

Electrical Age Publishing Co.

Dear Sirs:—Your invitation to readers to use the Inquiry Column is kind in the extreme. I take advantage of the same in asking you the following technical question: Why is an E.M.F. generated by a wire moving across or cutting lines of force? The reply you may give is being waited for with considerable curiosity.

Yours faithfully,
Pierre Delong.

(A.)—When a wire cuts a line of force a magnetic whirl is set up around the wire. A molecular change occurs of a purely physical character, but of a nature unknown to us. The wire becomes the centre of a whirling ether vortex generating potential instantaneously. Maxwell's works may be of interest to you.

(Q.)—TROLLEY ROADS.

Boston, Dec. 20, 1896.

Editor Electrical Age.

Dear Sir:—Will you kindly inform me in your valuable columns whether the welded rail is a success or not? I have been sufficiently interested in the subject to ask your aid. In many cases adverse reports have reached me regarding their use and I am desirous of being correctly informed.

Yours respectfully,
M. MacIntire.

(A.)—Welded rails are excellent from an electrical standpoint, saving binding and its accessory difficulties. On the other hand trouble is experienced in keeping the rail in place and in repairing any part that may get worn.

NOTES.

Mr. H. C. Hawks, president of the Anchor Electric Co., Boston, Mass., was in town this week and closed with Messrs. Jahl & Ellis, of No. 39 Cortlandt street, N. Y., to hustle their goods in this territory.

James L. Dixon, of San Francisco, California, is in town this week. Mr. Dixon is introducing his frosting process for incandescent lamps, by placing agencies in every large city. The process is owned by the United Specialty and Frosting Process Co. That he has met with success can be gathered from the many orders he has received in New York, Boston and Washington. Lynch's big jewelry store, 14th street and Broadway; Baumgarten & Co., 5th avenue, and Michaels & Popham, 5th avenue, this city, have all their lamps treated with this process and are delighted. They claim one-third increase in diffusion of light by this process.

C. L. Warrick & Co., of 136 Liberty street, N. Y., are a popular and energetic young firm who are not only able to pick out a good thing but, better still, know how to utilize the same to the best advantage of their customers. They are doing a big trade in the "Essex" incandescent lamp, for which they are the sole agents; this lamp being the equal, if not superior, to the best. They are also direct selling agents for all kinds of electrical supplies and construction material, the best makes of arc lamps (long life) with or without enclosed globe, and either plain or ornamental. They supply goods just as ordered and take the greatest pains to please their customers, thus securing future orders. Drop in and see them at the above address or write them and they will call with prices and samples.

In our issue of Dec. 26, 1896, we stated that Messrs. Jahl & Ellis, 39 Cortlandt street, N. Y., were agents for the Interior Conduit & Insulation Company. This was an error, as they are only selling the Interior Conduit & Insulation Company's goods. Messrs. Jahl & Ellis are "hustlers" in the true sense of the word, and are anxious to handle all first-class lines of electrical goods.

Mr. Chas. E. Brown, who will be remembered as one of the pioneers in central station work and recently attached to the sales department of The C. & C. Electric Company, has resigned his position with that company with a view to taking up special work.

Mr. S. C. Schenck, for a number of years the New York expert for The C. & C. Electric Company, has resigned his position and has formed a connection as an associate with Mr. Thos. J. Fay, the late general manager of The C. & C. Electric Company. They are New York Agents and exclusive exporters to Mexico, Central America, South America and the West Indies for the Crocker-Wheeler Electric Co.

CANADIAN LETTER.

Montreal, Que.—The increase in incandescent lights in the Royal Electric Company for the week ending on the 5th of December numbered 592. The total number now in operation is 61,283.

Gananogue, Ont.—W. J. Hands, late of the Electric Light Co. of this town, has been appointed chief electrician at the Upper Canadian College, Toronto.

Arnprior, Ont.—It is said that an Ottawa firm will put in an electric plant in Arnprior, locating the power house at McCuan's Mill.

Three Rivers, Que.—The electric light plant has been out of order for nearly a week and no one seems to know when it will be in the working order of last week. Oil lamps are in great demand.

Chatham, Ont.—The city council have decided to submit a by-law, providing for the expenditure of $15,000 in the purchase of a civic electric lighting plant.

Frederickton, N. B.—It is probable that an electric fire alarm system will be installed.

Kaslo, B. C.—George Alexander will put in an electric light plant.

Rossland, B. C.—J. T. McLaughlin, late of Toronto, has purchased the charter of the Spokane and Columbia Telephone Company. He intends to put in a system at Rossland first, then extend it to Trail, and from that point to Spokane.

Amherstburg, Ont.—The Amherstburg Electric Light and Power Co., which was recently organized to take charge of the incandescent lighting business of W. H. McEvoy, has purchased a 1,000-light single-phase alternator from the Canadian General Electric Company, the 500-light unit of the same make originally installed two years ago having proved too small to keep pace with the rapid growth of their lighting business.

Hamilton, Ont.—Some change has been made in the plans of the Cataract Power Co. of Hamilton. It has been decided not to acquire the De McCue's Falls, but to cut across the country for a short distance with the water course. Professor Paterson has made satisfactory arrangements with the St. Catharine's Water Commissioners. The company has closed contracts to supply power to the Hamilton Electric Light Co. and H. G. and B., and has applications for terms from a number of other companies.

Emil Gabel & Co., sole eastern agents for Monarch rivetless and Bradford dynamo leather belting, lace leather and general mill supplies, also direct agents for the original Gandy stitched cotton duck belting, 44 Dey street, New York, through their representative, Mr. F. H. Johnson, secured orders for the largest belts ever furnished, as follows :

The largest belts ever furnished to an electric light and power plant east of the Mississippi; one belt 80 inches wide, 165 feet long and three hides thick, pure oak tanned in the old-fashioned way. It is to go into the Jersey City plant of the People's Light and Power Co. One 72 inches by 130 feet long for the People's plant in Orange, besides 48-inch, 36-inch, 21-inch and smaller widths of belts averaging 70 feet in length.

Emil Gabel & Co. furnished all the belts exclusively for the Manhattan, Mt. Morris, Madison avenue Electric Light Companies in New York City, the Yonkers, N. Y., Electric Light Plant and the Brooklyn Heights Railway Company.

The Midvale Steel Works, Nicetown, are about to extend their ordnance machine shop 128 feet, at a cost of about $20,000. Alterations are also to be made to the hammer house, the entire work costing about $25,000.

CUSTOMERS OF THE MANHATTAN ARC LAMP.

	Orders.	Lamps.
Edison Electric Ill'g Co., Boston, Mass.,	15	1,027
Edison Electric Ill'g Co., Brooklyn, N. Y.	6	911
Metropolitan St. R'y Co., New York,	32	389
Edison Ill'g Co., Cleveland, O.,	56	360
Edison Electric Co., New Orleans, La.	19	282
Edison Ill'g Co., Detroit, Mich.,	35	280
A. E. Brooke Ridley, San Francisco, Cal.,	7	164
U. S. Capitol, Washington, D. C.,	4	148
N. Y. and Brooklyn Bridge, Brooklyn, N.Y.	6	137
Washburn & Moen Mfg. Co., Worcester, Mass.,	2	41
Bureau of Engraving and Printing, Washington, D. C.,	1	30
Bloomingdale Bros., New York,	4	22
Keith's Theatre, Boston, Mass.,	4	21

Charleston, S. C.—The Enterprise Railroad Co. will be ready to receive bids for the reconstruction of its line for the use of electric motors, in the near future.

Washington, D. C.—The Metropolitan Railway Co. has decided to extend its electric system to the Zoological Gardens, if permission is obtained from the district authorities. William J. Wilson, secretary.

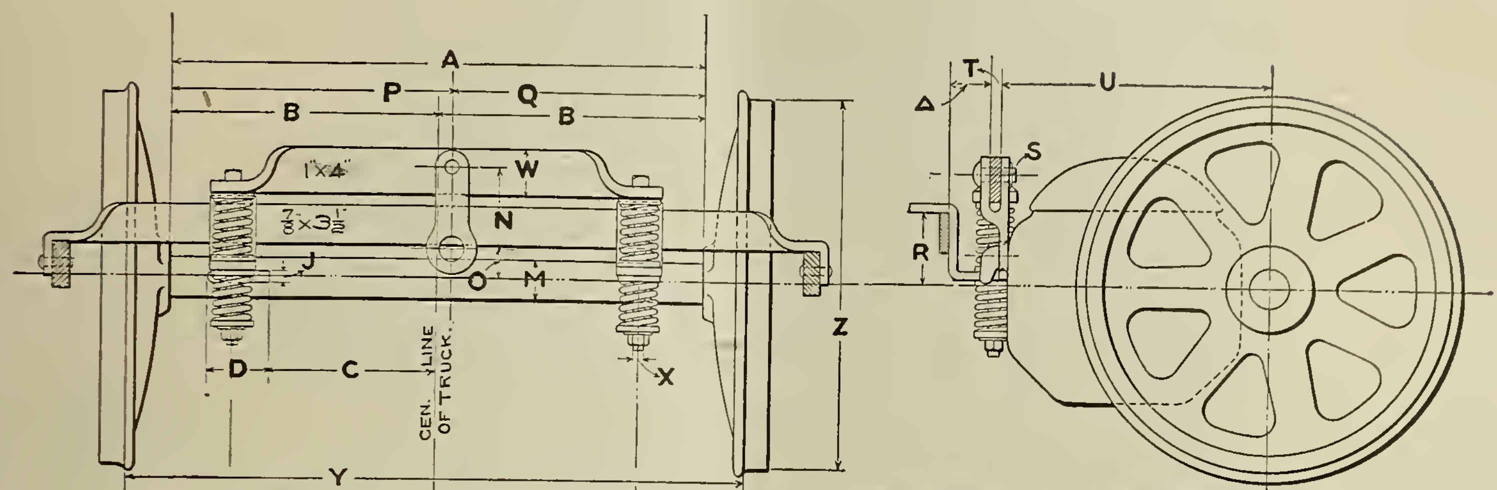
Savannah, Ga.—The franchise and property of the Electric Railway Co. will be sold at public auction in this city on January 5, 1896.

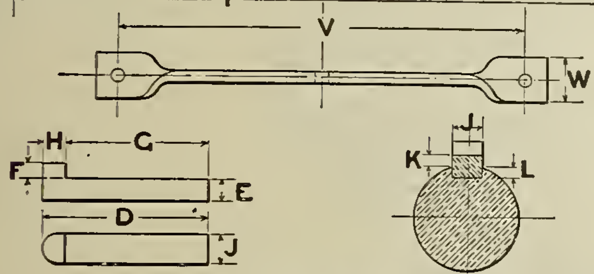
DAVID LEONARD BARNES.

David Leonard Barnes, consulting engineer, died in this city on Monday, December 21. Mr. Barnes's name had become well known to the public recently as consulting engineer to the Baldwin-Westinghouse combination for building electric locomotives. In the service of those companies Mr. Barnes designed a set of standard electric locomotives for a variety of services.

The Electrical Age.

Vol. XIX., No. 2. NEW YORK, JANUARY 9, 1897. Whole No. 504

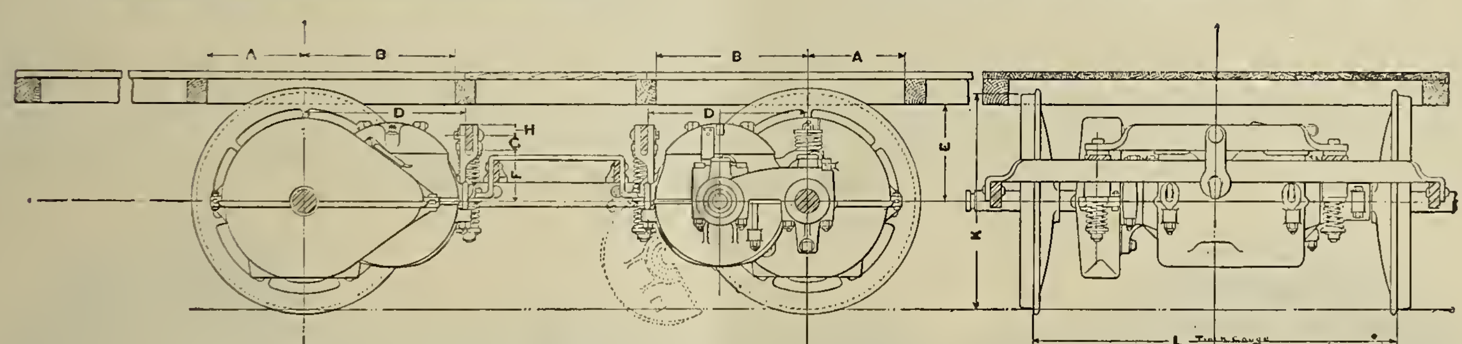


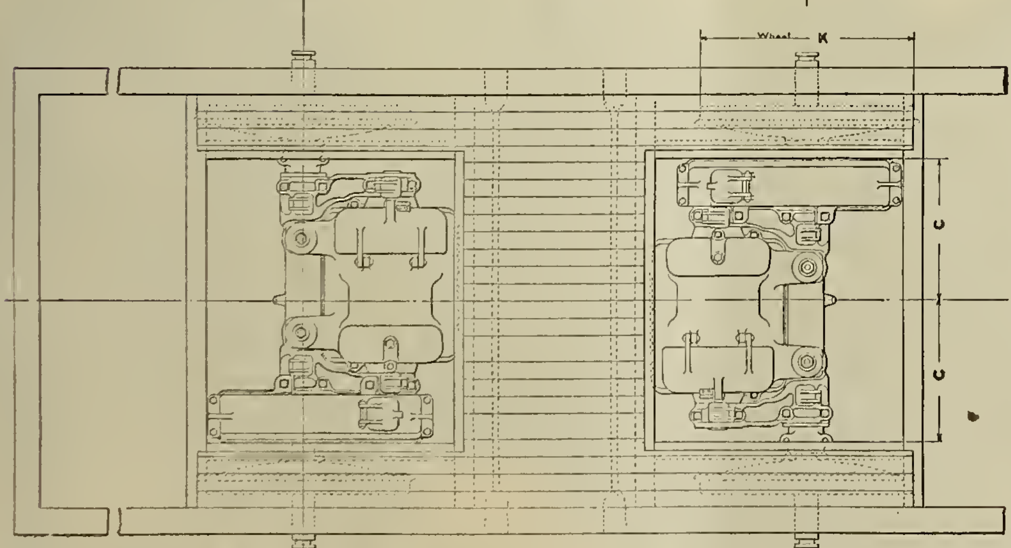


CROSS SECTION OF KEY & AXLE

TRUCKMAKERS DIMENSIONS

No	3S	4A	5	10	No	3S	4A	5	10
HP	25	30	35	50	HP	25	30	35	50
A	4'-0"	4'-0"	4'-0"	4'-0"	O	$2\frac{7}{8}$	$3\frac{7}{8}$	$2\frac{7}{8}$	$2\frac{7}{8}$
B	24"	24"	24"	24"	P	$25\frac{3}{8}$"	24"	24"	26"
C	15"	15"	15"	$16\frac{5}{16}$"	Q	$22\frac{5}{8}$"	24"	24"	22"
D	$5\frac{1}{2}$"	$5\frac{1}{2}$"	$5\frac{1}{2}$"	$6\frac{5}{8}$"	R	$6\frac{1}{2}$	$7\frac{1}{2}$"	$6\frac{1}{2}$"	$6\frac{1}{2}$"
E	3/4"	3/4"	3/4"	3/4"	S	$1\frac{1}{4}$"	$1\frac{1}{4}$"	$1\frac{1}{4}$"	$1\frac{1}{4}$"
F	1/2"	1/2"	1/2"	1/2"	T	1"	1"	1"	1"
G	$4\frac{1}{16}$"	$4\frac{3}{4}$"	$4\frac{3}{4}$"	$5\frac{3}{4}$"	U	$24\frac{3}{4}$"	$24\frac{3}{4}$	$24\frac{3}{4}$	$28\frac{1}{2}$
H	$1\frac{7}{16}$"	3/4"	3/4"	7/8"	V	$36\frac{1}{2}$"	$36\frac{1}{2}$	$36\frac{1}{2}$	46"
J	1"	1"	1"	1"	W	4"	4"	4"	4"
K	3/8"	3/8"	3/8"	3/8"	X	1"	1"	1"	1"
L	3/8"	3/8"	3/8"	3/8"	Y	4'-$8\frac{1}{4}$"	4'-$8\frac{1}{4}$	4'-$8\frac{1}{4}$"	4'-$8\frac{1}{4}$
M	$3\frac{1}{2}$	$3\frac{1}{2}$"	$3\frac{1}{2}$"	4"	Z	33"	33"	33"	33"
N	$7\frac{1}{8}$"	$7\frac{1}{8}$"	$7\frac{1}{8}$	$7\frac{1}{8}$	Δ	$3\frac{1}{4}$"	$3\frac{1}{4}$"	$3\frac{1}{4}$	$3\frac{1}{4}$"





No	3N	3S	4A	5	10
HP	15-25	15-25	20-30	25-35	35-50
A	15	15	15	15	17
B	$23\frac{1}{2}$	$23\frac{1}{2}$	$23\frac{1}{2}$	$23\frac{1}{2}$	27
C	$18\frac{1}{2}$	22	22	22	$22\frac{1}{2}$
D	25	$24\frac{3}{4}$	$24\frac{3}{4}$	$24\frac{3}{4}$	$28\frac{1}{2}$
E	15	15	15	15	17
F	$7\frac{1}{2}$	$7\frac{1}{2}$	$8\frac{1}{2}$	$7\frac{1}{2}$	$7\frac{1}{2}$
G	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$
H	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$
K	33	33	33	33	33
L	$39\frac{3}{8}$	$56\frac{1}{2}$	$56\frac{1}{2}$	$56\frac{1}{2}$	$56\frac{1}{2}$

Walker Company
Cleveland Ohio USA

Arrangement of Trap Doors

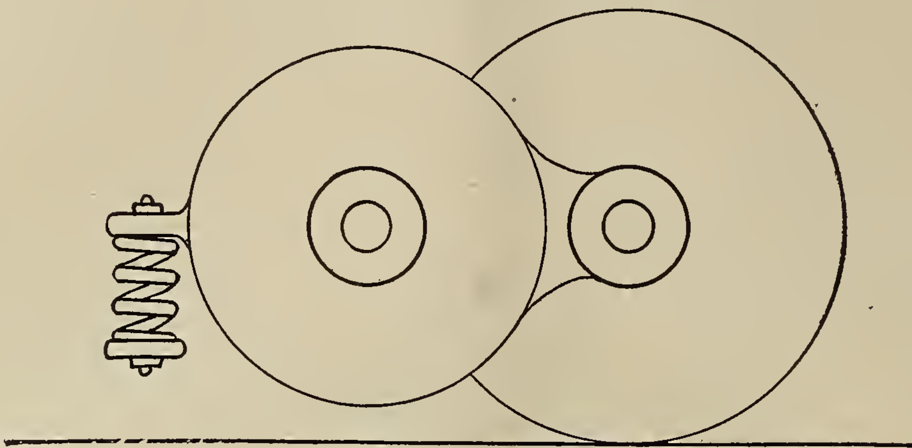
THE SPRING SUSPENSION OF MOTORS.

A famous railway engineer once stated at a public gathering that with poor tracks the locomotive or moving vehicle is always climbing up hill. The rail being poorly attached to the road-bed bends into an arch of appreciable magnitude, and the wheels traversing it must move up to its crest.

The gentleman furthermore stated that a considerable percentage of power was lost, due to this fault. In other

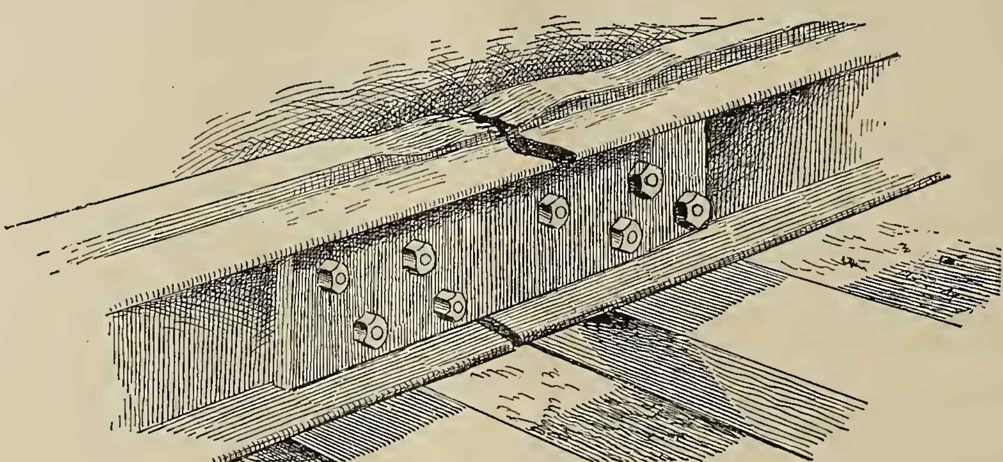
similar fields of work, difficulties lie hidden of the same simple nature that are only discovered by a thoughtful mind and experienced observer.

There is hardly a person living in civilized communities only in the case of steam cars, but of those depending upon the electric current for their progress. The leap the wheels make in passing from the end of one rail to the beginning of the next means the landing of a crush-



The Wheelbarrow Method of Suspending Railway Motors.

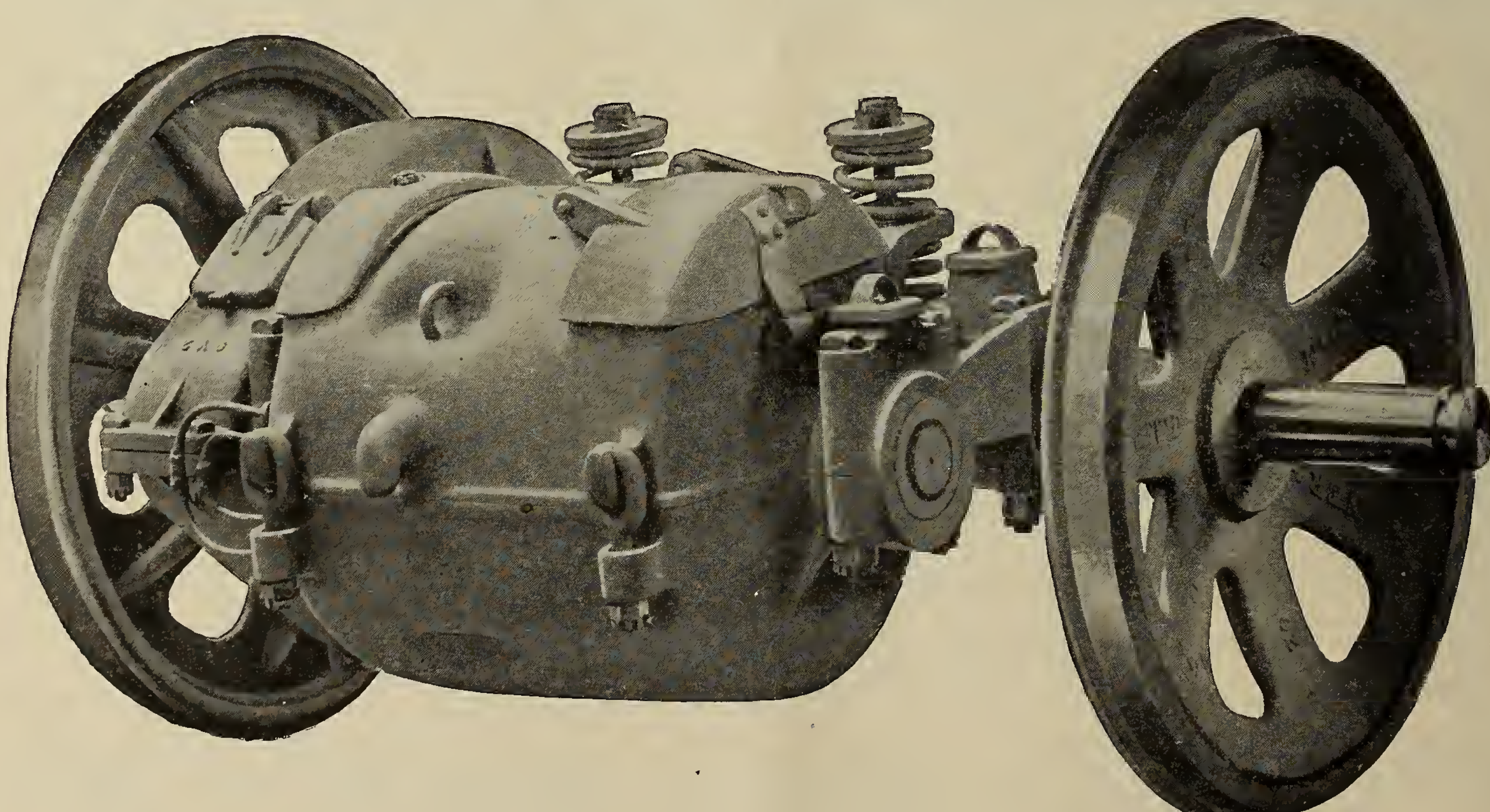
who has not at some time in his career noticed, while travelling, the systematic bounce and jolt of the car as it passes swiftly along. The sound increases in frequency and distinctness with each fresh impetus, and its ing dead weight that will, in the course of time, pound the rail into a flattened mass and endanger the wheels. The landing of this mass, especially if it is due to a motor in a trolley car, will act like the delivery of a sledge-



The Effects of Pounding on Rails.

rhythm becomes a noticeable feature of the car's motion.

The thump from one rail to another and the bending of rails is the cause of much of this disturbance. The weight of the car as it passes over the intervening space hammer blow wherever it strikes, and a vibration and shock extremely unpleasant to the passengers within. The weighty mass must therefore be suspended in an elastic manner, so that the blow is not that of a colossus



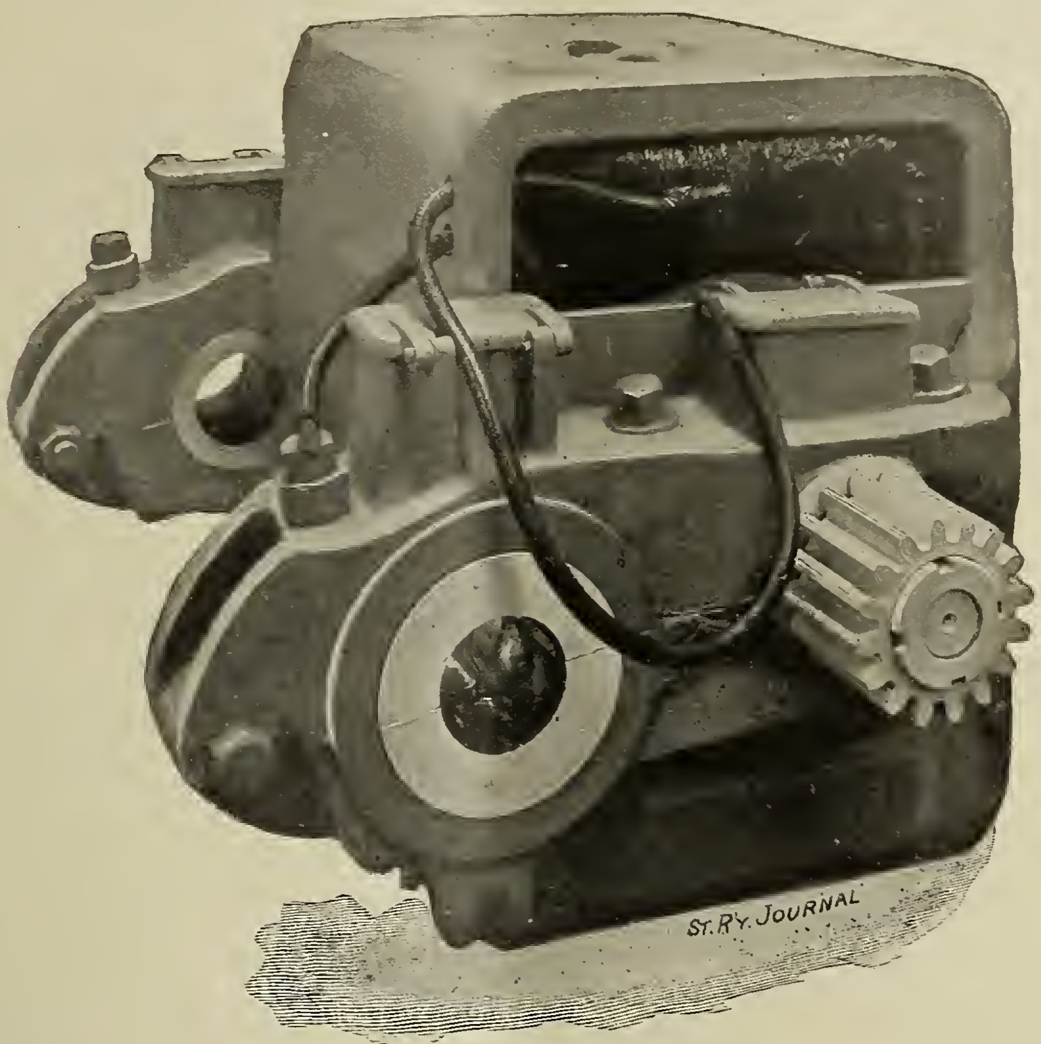
Front View of Spring-Mounted Street Railway Motor.

between two rails will be the factor that diminishes or accentuates this noise. The reduction of this sound will bring certain advantages of an unmistakable nature, not but of a springy and well-supported car motor. The Walker Company, of Cleveland, Ohio, have carried out this idea in a practical manner by suspending their car

motors on this plan. Their spring suspension relieves the track and passengers of the abrupt blows and discomfiture the previous absence of this improvement incurred. The illustrations show the principle upon which their method

by its utilization an amount of capital that can be but faintly conjectured.

The destruction of good machinery is likewise avoided and an important element of loss checked and reduced.



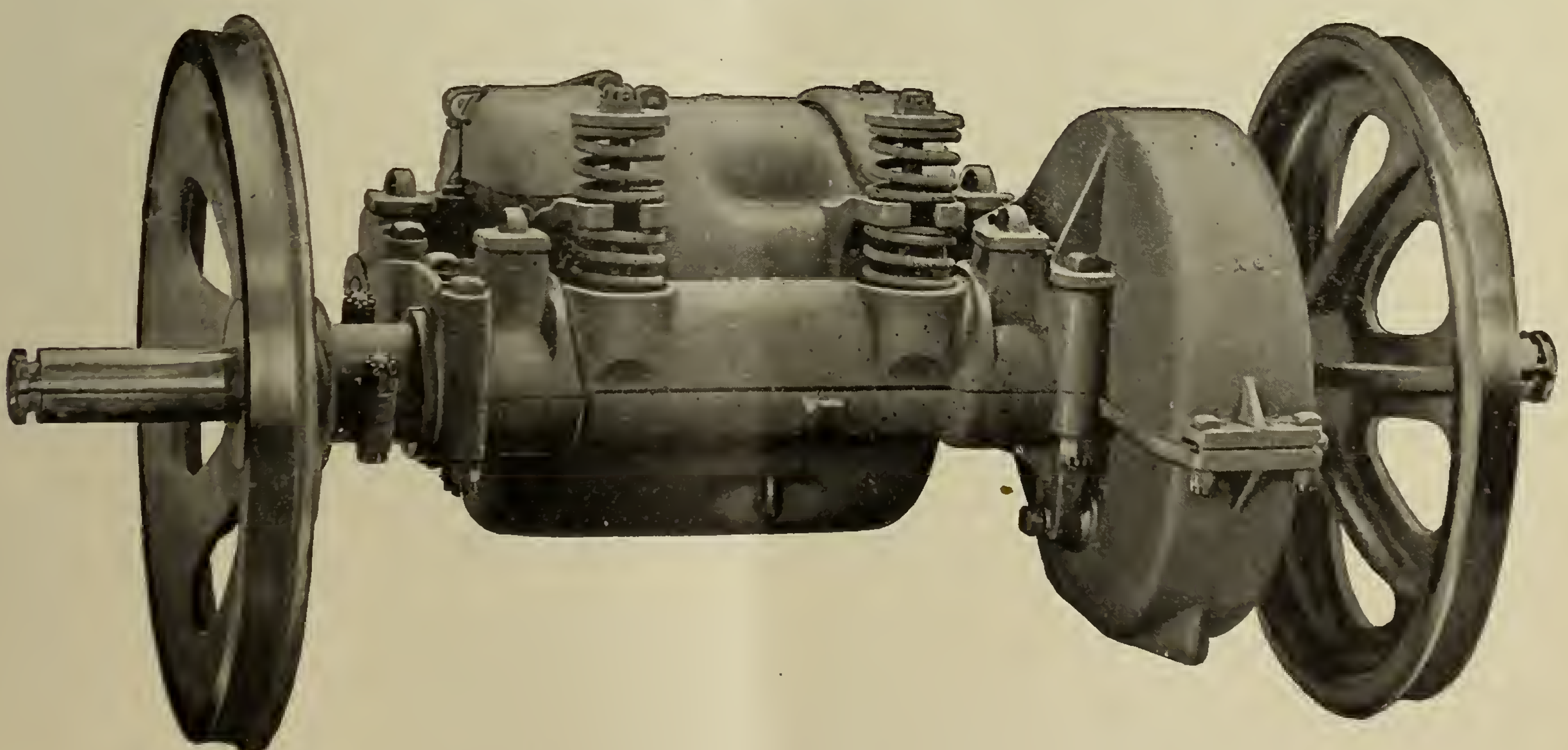
Walker 125 H. P. Street Railway Motor.

of motor suspension depends, as well as a few of the various styles of car motors they are at present manufacturing.

An engineering journal has stated that at a speed of ten miles an hour the pounding effect was seven and one-half times greater with a rigid load when passing over *an*

Shawville, Que.—An electric light plant is to be established in Shawville. The town has offered the company twenty years' exemption from taxation.

Almonte, Ont.—The Almonte Electric Light Company has recently added to its plant and the company is extending its service.



Rear View of Spring-Mounted Street Railway Motor.

eighth of an inch obstruction than with the load spring supported; and that, at twenty-five miles an hour, the blows delivered were forty-two times as great. This, then, is one of the great mechanical secrets that will save

Scotstown, Que.—The Canadian Telephone Co. propose to extend its line from Scotstown, via Milan, and Marsboro, to Lake Megantic Village. Electric light is also talked of for the village.

ALTERNATING currents have been employed for lighting in this country, and they have been especially valuable where a district is to be supplied in which the distances are considerable as compared with a number of customers. It has been almost the universal custom to supply small transformers for each consumer, and while the average size of transformers is greater now than it was a few years ago, yet they are comparatively small. No power has been supplied from such stations, and although alternating arc lamps are used to a limited extent, yet the number is not increasing, and in some cases continuous current arc lamps have been substituted for the alternating. Under these conditions the load on the station is even more variable than in the case of a continuous current supply where motors may be employed and the constant loss due to the large number of small transformers used, places this system at a disadvantage as compared with the continuous current system. The great advantage it possesses lies in the increased area of distribution rendered possible by the high voltages that are used, together with the possibility of locating the stations where power can be cheaply made. Abroad in the last few years most of the new stations that have been built use continuous currents, although some years ago the greater proportion of them were alternating current stations. It is also the custom abroad to use sub-stations with large transformers for distribution, thus doing away with a considerable part of the constant loss due to the small transformers used here. It is not possible, at the present time, without greatly complicating the system, to obtain a steady load on the station, and the only question that arises is the value of sub-stations, and the possibility of using some form of alternating current other than the single-phase.

METHODS OF ELECTRICAL TRANSMISSION.

Coming to the question of transmission of electrical energy as distinguished from the supply to customers from distributing centres, there have been great advances made in the last few years, and these mainly through the introduction of multiphase alternating currents. Single-phase alternating currents permit the transmission of power to long distances and its distribution for lighting purposes. It is also possible to supply power from such circuits to large motors working under a steady load. It is not possible, however, to distribute power economically for ordinary uses. As most long distance transmission schemes contemplate the substitution of electrical motors for steam-engines, and as their success will, in many cases, depend upon the possibility of such substitution, single-phase alternating currents are not at present able to comply with the conditions imposed by the desired service. The introduction of multiphase alternating systems, where two or more alternating currents are employed, the currents differing in phase, has completely changed the situation with respect to long distance transmission. I shall consider briefly the possibilities of such systems and their value as compared with any direct current system.

CONTINUOUS CURRENT TRANSMISSION.

The first long distance transmission plant was operated by the continuous current system, and even now plants are being built in which continuous current of high potential are used to transmit energy to distances up to 15 miles. As compared with transmission by means of alternating currents, we will find that the continuous current system possesses some advantages and some disadvantages. If we consider the relative cost of the copper in the line for a given amount of power transmitted and for a given maximum potential between the conductors, we will find that the relative amounts for the continuous current and the different alternating current systems will be as follows:

Continuous Current, - - - -	100
Single-phase Alternating, - - -	200
Two-phase " - - -	200
Three-phase " - - -	150

We see, then, that the continuous current has a marked advantage over the alternating current systems as far as the cost of copper is concerned. There are, however, certain practical disadvantages belonging to this system. The high voltages necessary for long distance transmission make it impossible to distribute the current at the receiving end without first reducing the voltage. With continuous current this can only be done by employing a rotary commutator of some kind. A plan which has been practically and successfully used has been to run a number of dynamos in series at the generating end of a line, while at the receiving end are a number of motors, also arranged in series, which are used to drive other generators to give the required type of current and the desired voltage. It has not been found possible to make either dynamos or motors of any great output, as there are practical difficulties in running dynamos of high potential where the current taken from them has a considerable value. M. Thury has installed a number of continuous current transmission plants that have apparently given excellent results. At Biberist, a transmission of 15 miles is employed. At Brescia, 700 H. P. are transmitted over 12 miles at a maximum of 15,000 volts. M. Thury states that generators for 45 amperes can be constructed up to 3,000 volts, and he thinks that 4,000 could be successfully used. These machines, however, are small when compared with the 5,000 H. P. dynamos in use at Niagara, for instance, and where the transmission is a large one the great number of machines necessary would be a serious objection to this type of transmission. It will be seen that the greatest possibility of trouble, in such a transmission, lies at the ends of the line, in the generating and receiving apparatus. It is necessary, no matter what our voltage is, that both the dynamos and motors shall be directly subjected to it, and this with commutated machines will always be a source of danger. If we are to do any considerable amount of lighting from such a station, our energy for this purpose undergoes three transformations before it reaches the lamps, and the efficiency would not be so high as in a corresponding alternating current system. It would hardly be possible to supply motors for ordinary work at the high voltages used for transmission, and the current for them would have to be transformed in the same manner as the current for the lamps. It must be recognized, however, that this system has been successfully used and has given excellent results in a few cases of transmission. Its great advantage lies in the decreased amount of copper as compared with the alternating systems, and in the absence of induction effects, which are a drawback to alternating current transmission.

TRANSMISSION BY ALTERNATING CURRENTS.

A large proportion of the transmission plants that have been installed in the last few years have been of the alternating current type. These have, as a rule, given satisfactory results, and the installations that are now being erected or planned are almost exclusively on an alternating current basis. The great advantage of this system lies in the fact that it is possible to change the voltage of the current without the use of rotating apparatus, and at once economically and safely. Low voltage dynamos may be used; the voltage may be increased in any desired ratio by stationary transformers; the energy may be transmitted at an increased voltage and at the receiving end the voltage may again be reduced by transformers. If we compare this method with the continuous current system, we will see that to obtain an alternating current of the required pressure at the receiving end of

the line, we would use the same number of transformations required by the continuous current system. We have the great advantage, however, that our changes in voltage have been obtained by the agency of stationary apparatus, which is much cheaper, is more efficient and is safer than that required in the continuous current system. It is possible to increase the voltage by means of transformers to almost any value with perfect safety and with an efficiency as high as 98 per cent. or 99 per cent. If then our alternating current, when it has been reduced at the receiving end, is as valuable for distribution as the current obtained by the direct-current system, there will be no doubt that alternating transmission has great advantages over continuous currents.

(To be continued.)

SPONTANEOUS IGNITION OF COAL.

The spontaneous combustion of coal has been a fruitful cause of discussion in the past, and many are the theories advanced to account for the phenomenom. One of the latest writers on the subject is Professor Meden, who traces spontaneous combustion to the oxidation of iron pyrites. He gives the following account of the causes of the combustion of hay and coal, and the methods provided for its suppression and prevention. He tells us that the simplest form of spontaneous ignition is exhibited by dry spongy platinum, and is distinctly due to the absorption and condensation of oxygen within the pores of the metal itself. If this metal is exposed to a current of hydrogen gas, chemical combination will be the result, with a rapidly rising temperature, sufficiently high to ignite the stream of hydrogen. In the case of charcoal, it is only when some of the volatile hydrocarbons have been left behind that any pyrophoric tendency is observed. These hydrocarbons which are left behind after the distillation process enter very quickly into combination with the absorbed oxygen. On the other hand, when such charcoal is freely exposed to the air, the external portions very rapidly lose this property, because the pores themselves become fully saturated with air. If, however, it is reduced to powder, it soon regains its pyrophoric character, and it is discovered that all the internal layers are enabled to absorb oxygen.

The combustion only goes on in the interior of a heap of charcoal; thus the way to arrest it would be to spread the charcoal out in thin layers. Any attempt to block it by drawing air through the mass would only increase the combustion tenfold. Powdered charcoal once cooled by direct exposure to the air loses its pyrophoric properties, and never regains them, although in the lump, however much it may be broken, the danger of ignition will constantly occur. The hard and brown coal are both subject to explosion and ignition, but from different causes. Explosion is due to the liberation of a certain gas known as fire-damp, which follows on a decrease of the atmospheric pressure, whereas ignition results solely from the oxidation of the iron pyrites contained in the coal, the said pyrites being exposed to the action of oxygen and moisture. The finer the state of division of the coal, the greater the danger will be. Coal stacked above ground is particularly liable to this.

Numerous attempts to reduce this danger have been made, principally by ventilating the stacks. This course has, however, failed on account of the increased amount of oxygen introduced into the interior of the mass. The practice of ventilating the coal bunkers of ships has not, even up to the present, been totally abandoned, notwithstanding the unfavorable reports which have been made upon the subject, and such impressive warnings as that given by Liebig as far back as 1866. Many very lamentable fatalities have occurred owing to the authorities neglecting this warning, and no less than 97 coal-laden vessels are said to have been destroyed by spontaneous ignition of the cargo since the date above mentioned. It is very desirable that this subject should be thoroughly investigated, and rules laid down for those working in coal-mines or coal-laden ships.—London Invention.

TWENTY-FIFTH ANNIVERSARY OF THE STEVENS INSTITUTE OF TECHNOLOGY.

A noteworthy event in the annals of technical education in the United States will be the forthcoming celebration of the twenty-fifth anniversary of the Stevens Institute of Technology, on the 18th and 19th of February next.

The festivities will consist of a banquet, at the Hotel Waldorf, New York, to which representative engineers and technical educators throughout the country will be invited. On the following day the institute will be open for inspection, and the methods of instruction, together with the apparatus in the various laboratories, will be explained.

Not the least interesting feature of the exhibition will be the collection illustrating the work of the alumni, and consisting of machinery, apparatus, drawings, etc., representing the product of their activity during the twenty-five years.

The festivities also include a reception, tendered to the faculty, graduates and undergraduates, by Mrs. E. A. Stevens, widow of the founder of the institute, at Castle Point, Hoboken; a promenade concert and dance in the evening will conclude the celebration.

The Stevens Institute of Technology was founded by the late Edwin A. Stevens, of Hoboken, N. J., and in 1870 the erection of a building was commenced by the trustees, Mrs. E. A. Stevens, Mr. S. Bayard Dod and Mr. W. W. Shippen. Dr. Henry Morton, at that time secretary of the Franklin Institute of Philadelphia, was tendered the presidency of the institute, and gathered a faculty of eight members about him. To this number others have from time to time been added, as the work of the institute increased, until at the present time the faculty includes twenty-two professors and instructors. The total number of student graduates is 675, and the number in attendance during recent years has been about 260 each year.

The Stevens Institute has always taken high rank among the institutions devoted to technical education in the United States, and its twenty-five years of successful effort is amply exemplified in the work accomplished by its graduates in all departments of mechanical and electrical engineering.

A reference book of much value to the trades is the "Building and Engineering Trades Directory," issued from the office of F. W. Dodge, publisher, 146 Franklin street, Boston. It contains a complete list of the architects and engineers of New England, also the contractors and builders, manufacturers and dealers in all materials, apparatus and appliances used in the construction, furnishing and equipment of modern buildings and engineering projects, and includes the various branches of engineering; such as bridge, civil, electric, hydraulic, mechanical, mill, steam, street railway and ventilating. It is so arranged and classified as to render it useful for reference to both buyer and seller. The system of cross indexing makes it very convenient for ready reference, and it contains features not to be found in any other work.

We congratulate the publishers on the high class of advertising, representing the leading firms of New England, which is well arranged and finely displayed. It reflects great credit upon the publishers, and the trades are fortunate, indeed, in having a work so thorough and reliable. Their next annual edition promises to even surpass this one.

BOOK REVIEWS.

We have received a prospectus of "The National Electrical Code," of which Messrs. Pierce & Richardson, of Chicago, are the authors. Mr. R. H. Pierce is a member of the American Association of Mechanical Engineers, the American Institute of Electrical Engineers, and the British Institution of Electrical Engineers, and was the chief electrical engineer of the World's Columbian Exposition.

The book is written in "ordinary language," and the text is the Fire Underwriters' Rules and Requirements, which must now be observed, and which directly concern architects, builders, contractors, electricians and engineers.

The book of 222 pages is printed on thick paper and bound in flexible leather covers, and is of convenient pocket size. Price, two dollars, cash. Sent postpaid on receipt of price. Address, The Electrical Age Publishing Co., World Building, New York.

We have received from the American Technical Book Company, 45 Vesey street, New York, *Dynamo-Electric Machinery*, by Silvanus P. Thompson, D. Sc., B. A., F. R. S. The work is published in two large 8vo volumes, handsomely bound in cloth and well printed on good paper, including 19 folding plates.

It is the fifth edition, recently revised by Prof. Thompson, and is undoubtedly the most important work on the subject. It is the graduating text-book in all colleges and schools of technology, and no electrician who has ambition to rise in his profession can afford to be without this excellent work.

We have also received a copy of Thompson's *Polyphase-Electric Currents and Alternate Current Motors*. This is the best work that we have seen on the subject. It is printed and bound in a style similar to *Dynamo-Electric Machinery*. The publishers inform us that they are placing these works, in both cloth and half leather binding, on easy payments. We cannot recommend the purchase of these excellent books too highly, as in all the range of electrical literature they are unquestionably the most important. The leather-bound three-volume set is very handsome and is in keeping with the high standard of the work.

ELECTRIC LOCOMOTIVE FOR SWITCHING.

The use of the electric locomotive for switching purposes in steam freight railroad yards is likely to receive a marked impetus by the fact that one is now employed in connection with the New York, New Haven and Hartford Railroad at New Haven, Conn.

This locomotive is in constant service switching freight cars between the main line of that road and a number of factories located along the river front.

The line over which it operates is about two miles long and is the property of several large manufacturers—the Bigelow Company, manufacturers of boilers; the National Pipe Bending Co., the Quinnipiac Brewing Co., the New Haven Rolling Mills and others. It starts at the tracks of the N. Y., N. H. and H. R. R. at Cedar Hill Junction, which is located about one mile from the New Haven passenger depot, and follows a devious course, throwing off sidings at each of the different factories. The track is of regular steam railroad type, with heavy steel rails,

Electric Locomotive used on the N. Y., N. H. & Hartford R. R.

well-ballasted and provided with switches and turnouts. In addition to the curves there is a $2\frac{1}{2}$ per cent. grade against the load both ways on each side of Grand avenue.

The practice followed by the manufacturers hitherto in switching their cars has been for the freight engines of the N. Y., N. H. and H. R. R. to drop the cars at the junction; from here they were hauled to the different factories by horses. This method was so slow with the several curves and grades, and so hard upon the horses, that the manufacturers were driven to the conclusion that some other method of traction must be employed. Steam traction was rejected, for the excellent reason that the line runs for some distance along a frequented thoroughfare where a switching engine would be a dangerous adjunct. That the steam locomotive would also be standing idle under steam for a large part of the day and consuming coil uselessly was also a weighty consideration.

Electric traction was finally adopted as presenting many economical and other advantages, and an order was placed with the General Electric Company for a 30-ton locomotive, which the company could guarantee would

(Continued on Page 26.)

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CONTENTS.

PROGRESS IN ELECTRIC TRACTION.

Menlo Park was the scene of the first endeavors of Edison to secure traction by means of the electric motor. Siemens, of Germany, had made a series of systematic efforts which terminated in the design of a successful electric car. And in England the ground was being broken from which was to spring a rich crop of inventions relative to electric locomotion.

The policy of conservatism has not affected the progress of electric traction. The first toy model built by a Vermont blacksmith, of what was destined to be the most popular of city conveniences, has at least marked the starting-point of which the heavy electric locomotive is the final consummation.

For so short a time a marvellous development has occurred. Leo Daft and Frank J. Sprague are names so dovetailed with the recent history of the subject that their association will never fail to revive a host of pleasing recollections to those whose fortune it was to help build the present solid foundation. The difficulties encountered and overcome; the numerous objections raised by that potent factor of municipal life, prejudice, and the eloquent arguments of the "I-told-you-so" fraternity at each retrogression, were collectively sufficient to have stemmed advance and fostered a waning ambition. But merely as memories do these things remain. The steam roads have long since realized that a new renaissance approaches; that not only may steam count its cars from this time on as a decreasing factor, but the flight from town to town and city to city will be accomplished in the near future with the rapidity and safety that only the high-speed electric car can give.

Heavy electric freight locomotives will be a common sight in the next few years, and the guarantees offered by our leading companies can hardly fail to impress the directors of all large steam roads, not only of the feasibility, but of the practical and commercial success that their introduction will establish.

THE RAPID DELIVERY OF ELECTRICAL MACHINERY.

The fact that about $55,000 worth of electrical machinery was delivered in the city of Newark two days after its great station had burned down speaks well for that particular concern, the Brush Electric Company, whose fortune it was to be able to show the ability and despatch required under such circumstances for the instant shipment of the apparatus.

We understand that passenger cars were utilized for the purpose of facilitating the transportation of the goods, showing that the greatest efforts were made to get the station in full working order as rapidly as possible.

The fire that burned this station and destroyed all its generators and switchboard was unusually severe. So total an annihilation is almost unprecedented in the annals of electric-light stations. Yet it has shown the surprising vigor possessed by its manager, to whom the shock of such a misfortune was the strongest spur to a most remarkable activity.

BANK FAILURES.

Tidal waves of financial ruin periodically pass over a country's banking and commercial institutions, leaving behind a debris of business ruin that is unrecognizable. Many students of these catastrophes believe that an analysis of them will enlighten us as to their cause and perhaps originate a suggestion that may prove to be an efficacious remedy.

But the strange medley of causes always presenting themselves are sufficient evidence of the fact that a chain of circumstances, the links of which were forged perhaps in days of balmiest prosperity, only find their final termination at this period. There is therefore no sudden cure to so advanced a disease. Speculation based upon expectation, and expectation born from the fevered investments of unconservative speculators, give rise to so complete a series of collapses as this year has caused us to witness. Then the hungry desire of those possessing "money power" gives them weapons for the attack and unworthy victory over their less fortunate brethren.

The reflective mind will also realize that many have patiently waited for an excuse to "turn their faces to the wall and weep." The dependence and interdependence of interlinking business circles is so great that the least disturbance destroys the fine balance, which, to the ordinary observer, expresses the utmost solidity and substance, but which is to the discerning eye a constant indication of impending distress.

ANOTHER CHAPTER FINISHED.

Last week a great many of our friends spent the last few hours of the afternoon before New Year's in the society of Messrs. Godfrey, Harrington & Olsen at their offices, No. 15 Cortlandt street. They are the agents for the Habirshaw wire, and threw open their rooms to the stream of people that considered it both a pleasure and a duty to call upon them. Friends arrived whose meetings with each other were of an annual nature, yet it is to the credit of their hosts that these meetings occurred within their rooms, in the warmth and geniality of a most friendly atmosphere. The last few business hours of the old year ding-donged on their swift career, leaving Godfrey, Harrington & Olsen's guests absorbed in each other and the rich redundancy of bottled happiness.

haul two loaded freight cars up a 2½ per cent. grade at a speed of seven miles an hour.

The locomotive was delivered at New Haven on the 8th of December, and on the 11th was put into actual operation without preliminary test on the line. Since that date it has been handling the entiie movement of the cars between the factories and the junction.

On receipt of the locomotive the manufacturers painted upon the cab the words "Manufacturers R. R. No. 1," and after two weeks' experience are extremely proud of their new acquisition.

The dimensions of the locomotive are as follows:

Weight	58,000 pounds
Draw-bar pull	7,000 "
Length over draw-bar	16 ft., 6 in.
Height over all	11 ft., 6 in.
Width over all	8 ft., 3 in.
Wheel-base	5 ft., 6 in.
Diameter of drivers	44 in.
Number of drivers (with cast iron centres and steel tires)	4
Size of journals	5½ in.
Gauge	4 ft., 8½ in.
Voltage	500
Amperes, full speed and normal draw-bar pull	600
Amperes, fair speed and normal draw-bar pull	300

The motors are two in number, each axle being provided with its own motor. The motors are gearless and are supported upon a system of spiral springs resting on the side frames of the locomotive truck. The suspension being entirely upon springs, the wheels are free to adjust themselves to the irregularities of the road-bed, and the wear on both tracks and motors is consequently diminished.

In the armatures the iron-clad type of construction has been followed; that is, the windings are placed in a mica-lined slot cut in the surface of the laminated core. The armature and conductor are upon a sleeve through which the axles pass. The sleeve rests in bearings on the motor frame. Two projecting arms from the sleeve fit into the openings in an iron plate loose upon the axle, and similar projections from the wheel enter the plate from the other side so that, as the armature revolves, the wheels are revolved also. This coupling, being flexible, allows perfect freedom of motion. The commutators are of substantial construction and each motor has four sets of brushes.

The truck is constructed of I-beams and forms the foundation for a locomotive cab of sheet iron, with sloping shields at each end. It has two hinged doors, one on each side, and sliding windows at the sides, the front ones being stationary. As there are windows on all sides the motorman has a view in all directions. The interior of the cab is finished in cherry and contains the rest of the electrical equipment—automatic circuit breaker, controller, lightning arrester, reversing switch, air pump, air gauge, etc.

The controller is the L2-series parallel type, arranged for the control of two motors. It is of the same general type as the K2, with which we are so familiar in ordinary street practice, and is provided with separate reversing switch and the magnetic blow-out. The resistances are set beneath the shields and are of the packed ribbon type.

The automatic circuit breaker is of 500-ampere capacity and involves also the magnetic blow-out principle, as does the lightning arrester, which is set upon the floor of the cab behind the controller. In the front of the cab and above the controller is a circular-dial ampere meter reading to 500 amperes, and facing the motorman is the air pressure gauge. On the other side of the cab, opposite the controller, is an oscillating cylinder air pump driven by a motor. This furnishes air to two air tanks suspended beneath the cab and is automatic in its action.

The air pressure pump is controlled automatically by a pneumatic governor, consisting of a cylinder containing a piston working against a spring. The action of this automatic control is as follows: A pipe running from the main reservoir enters the cylinder below the piston. As the pressure rises the piston is forced upwards against a spring. The other end of the piston rod carries the contacts through which the pump motor circuit is made and broken. When the pressure falls below that at which the automatic control is set, the spring forces the piston down and the circuit is broken. Any arcs that may be formed when the contact is broken are blown out in the magnetic field. The locomotive is provided with a chime whistle blown by the compressed air, and a railroad headlight is set upon each shield. Beneath each one of the shields is an iron sand box provided with pneumatic feeding device.

Electricity for this locomotive is furnished from the Fairhaven & Westville power house, which stands on Grand avenue, about the middle of the line, and the current is taken by trolley from an overhead wire suspended from brackets. The operation of the locomotive is marked by extreme smoothness, and without load it can be run at almost any speed, and with load starts without jerk of any kind. It responds immediately to the motion of the controlling lever and can be backed up to a freight car for coupling as gently as the movement of a hand. One of the difficult duties it has to perform is the kicking of the freight cars over the curves in the New Haven Rolling Mill, in which there is one with a radius of only 50 feet. The locomotive can handle seven heavily loaded cars around this curve as easily apparently as it can two. Its operation is already attracting considerable attention from railroad engineers, several of whom have already visited the scene of its operation. In order to show one of these engineers what the locomotive would do, six loaded cars were hauled up the steepest grade with the slack all out, the start being made on a grade of about one per cent. 150 amperes only were required to start this heavy train, and it moved off very smoothly and gradually.

ELECTRICITY ON THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD.

We find in the "American Engineer" the following:

Recent dispatches in the daily press state that while the leading officials of the New Haven road will not give the details of the reported three-rail electrical branch between New Britain and Hartford, via Berlin, they admit that the power station is practically assured, and that similar power-houses will be constructed in a short time on various branches of the main lines in this State. President Charles F. Clark, of the road, was interviewed and said:

"I am not prepared to say that work will immediately be begun on the erection of the power station at Berlin, but its erection has been under consideration for some time. An announcement that work will be immediately undertaken may or may not be made within a short time.

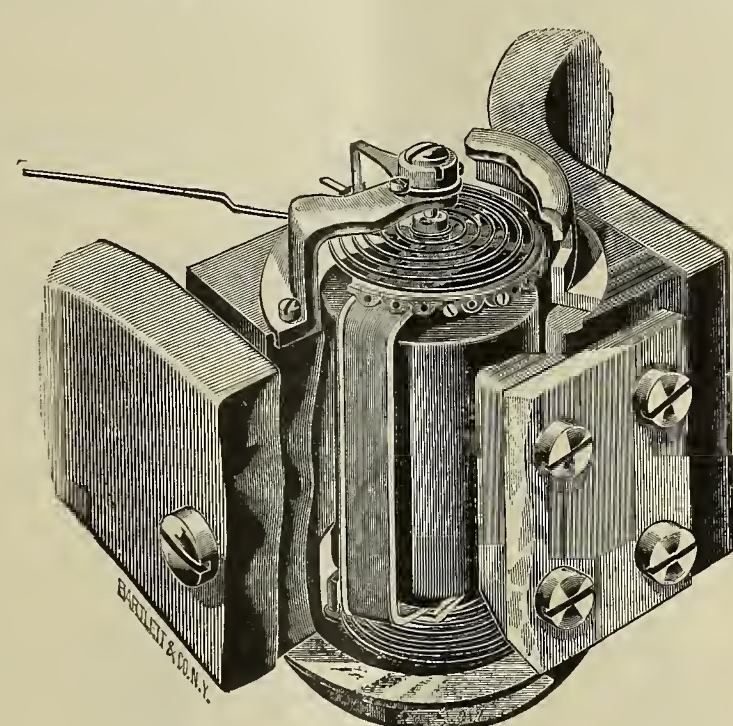
"The general policy of the New Haven road relative to the introduction of electricity as a motive power may be given as follows: Electricity as a motive power is foreshadowed in the last annual statement of the road. On the south shore branch of the Old Colony system, the current has been successfully and economically conveyed in a third rail, insulated upon wooden blocks in the centre of eaeh track. The results have surprised experts, and it is now probable that a third rail will be laid at various points upon the company's property during the year to come. Short branches to the centres of business and population may then be constructed from the company's lines."

THE MEASUREMENT OF PRESSURE.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

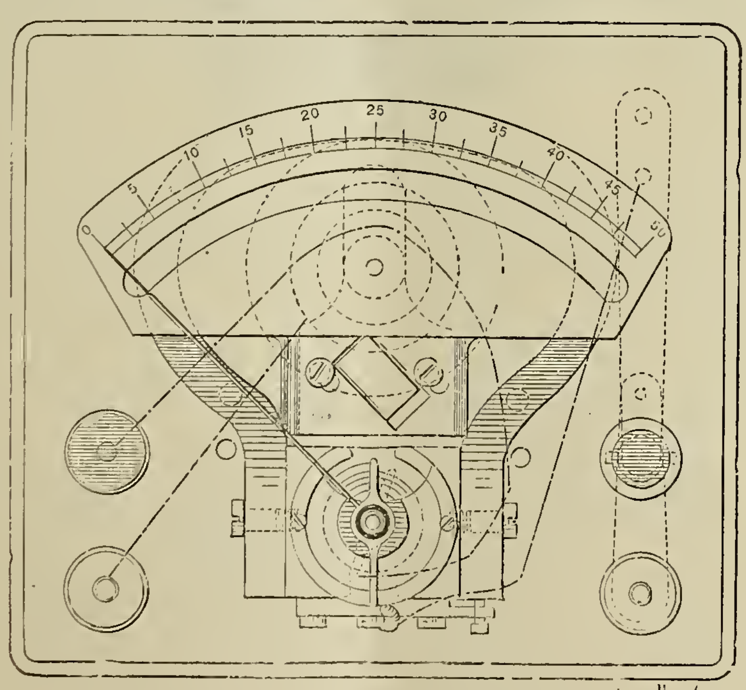
The flow of a current of electricity is directly due to the existence of an electric pressure in a wire. Although the evidence of its existence is not such as to give the same impression as would be received by viewing the steam



Mechanisn of Weston Instrument.

gauge on a boiler, or the barometer of an air-pump, the reality of its presence soon becomes firmly established in the observant mind.

The forms of apparatus used for the purpose of meas-



Connections of Weston Voltmeters.

uring an electric pressure may be subdivided into three general groups,

Electro-Thermal.
Electro-Static.
Electro-Magnetic.

The *electro-thermal voltmeter* is one in which the expansion and contraction of a metallic body causes a dial or pointer to move by the agency of some intermediate mechanism. The elongation of the wire is caused by the current, which can only increase or decrease when the pressure does likewise. Practically all current carrying voltmeters are of high resistance, and in this case there is no exception.

The best known type of instrument utilizing this principle is the Cardew voltmeter. A long wire of high resistance is strung between two pulleys, a pointer placed in front of a graduated dial is attached to one of them; when the wire stretches, due to the influence of the current, the little pulley over which the wire passes rotates and assumes different positions dependent upon the extent to which the wire has expanded.

By sending in known currents of increasing strength the positions of the pointer may be permanently marked for future measurements; the voltmeter is then said to be calibrated.

A spiral spring of high resistance material might be used; when the current had caused it to become perceptibly heated the elongation of the spring would become visible by its tendency to untwist. If one end be rigidly held the other could move a pointer, and thus perform the function required of it—the registration of different pressures.

The great object to be held in view in the construction of voltmeters should be their high resistance. The striking difference always noticeable between current and pressure measuring instruments is the very low resistance of the one and the extremely high resistance of the other.

Electrostatic instruments that measure volts do so without the consumption of any current.

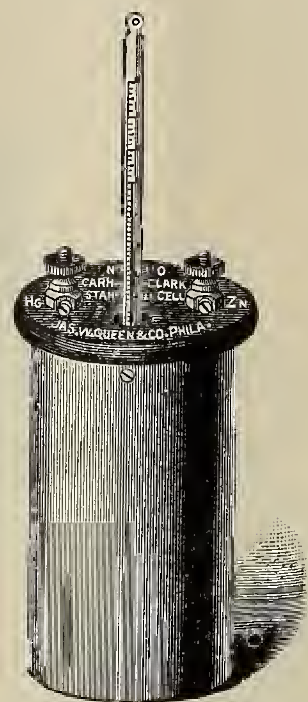
If any electric circuit be broken and the extremities examined, they will be found individually to possess a positive and negative charge. These terms are merely relative expressions for the potentials existing between

two points. An electrostatic instrument therefore simply indicates this condition and measures the difference of potential.

The electrometer which serves the above purpose acts upon a very simple principle. If two oval-shaped pieces of metal be placed at right angles to each other, one insulated and tightly held and the other suspended above the first by a silken thread, the following will occur:

By charging one positively and the other negatively, the upper one will be attracted out of its position and try to assume a new one directly above the stationary plate. The greater the charge on each, the greater the attraction exerted between them. By attaching a light pointer to the movable plate, or a mirror throwing a beam of light on a scale, the deflection can be accurately observed.

The laboratory instrument is the *quadrant electrometer*, while that employed for practical pressure measurements is the *electrostatic voltmeter*. As both depend upon the same principle, the only difference lies in their respective delicacy of construction.



Standard Cell.

The *quadrant electrometer* consists of four quadrants lying in one plane and insulated from each other by supports of glass. A metal needle, shaped like two opposite blades of a four-bladed fan, is suspended above by a fine fibre. A mirror attached to the thread and a scale in front for observing tht deflection complete the outfit. Two opposite quadrants and the needle are charged positively and the other two quadrants negatively from the circuit whose pressure is to be measured.

The result is:

$$\text{Volts} = \text{constant} \times \text{square root of deflection.}$$

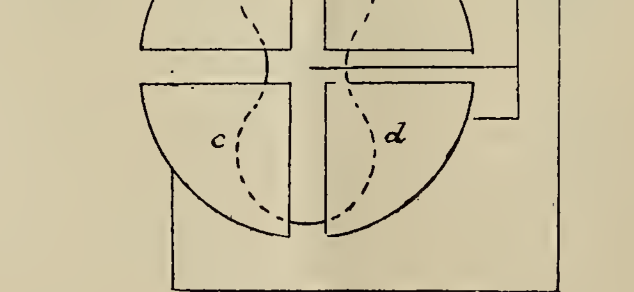
The constant can be found very easily by applying a known number of volts and noting the deflection, because

$$\text{constant} = \frac{\text{volts}}{\text{square root of deflection,}}$$

thus giving it for future use.

The development of the electrometer into a direct reading voltmeter was effected by Lord Kelvin in an interesting manner.

The electrometer was reduced to two long-shaped plates placed vertically, and between them on two light pivots swing the needle with a pointer attached. A small weight holds the needle at zero when readings are about to be taken, but do not prevent the two fixed plates from attracting it out of a perpendicular position where both they and it are oppositely charged. The weight can be changed, and thus increase or decrease the range of the instrument —a heavier weight requiring more difference of potential



Electrometer.

to move it than a light one. Thus the same scale can be used for hundreds or thousands of volts. The two fixed plates, though in a vertical plane, are inclined in position, the needle being held perpendicularly between tl.em until acted upon by the electrostatic attraction of the two parallel plates.

A quadrant electrometer can measure a very small difference of potential, a fraction of a volt from $\frac{1}{10}$ to $\frac{1}{50}$ being accurately determined.

An *electrostatic voltmeter* is used for very great pressures, their range including five or six thousand volts. An electrometer possesses the great advantage of being able to measure the pressure of an alternating current, although, to do so, the ordinary connections must be somewhat changed.

The electrostatic voltmeter can be immediately used for this purpose without change, as the reversals of potential do not destroy the attraction existing between plates and needle, whether the needle be positive and the two plates negative, or the needle negative and the two plates positive.

Electro-Magnetic.—A difference of potential can be measured by the electro-magnetic effects produced in a coil of wire, provided the general adjustment of parts be such as to enable the changes that occur to become evident. Those of the last named type have made use of the electrostatic force and do not depend upon a flow of electricity to produce readable effects; in this respect there exists an essential difference between them.

The simplest form of instrument by which an electric pressure can be measured consists of a coil of wire that attracts a soft iron core. The resistance of the coil is very high, being made of fine wire, and an additional resistance sometimes added in the form of a reel of german silver brings the resistance up to a very high point. A dial placed in front of an arm actuated by the moving core can be easily calibrated by the application of a series of known pressures, each being individually marked on the dial as the needle or pointer shifts, due to their influence.

A galvanometer can be used for the purpose of measuring great differences of potential by utilizing a shunt in connection with it.

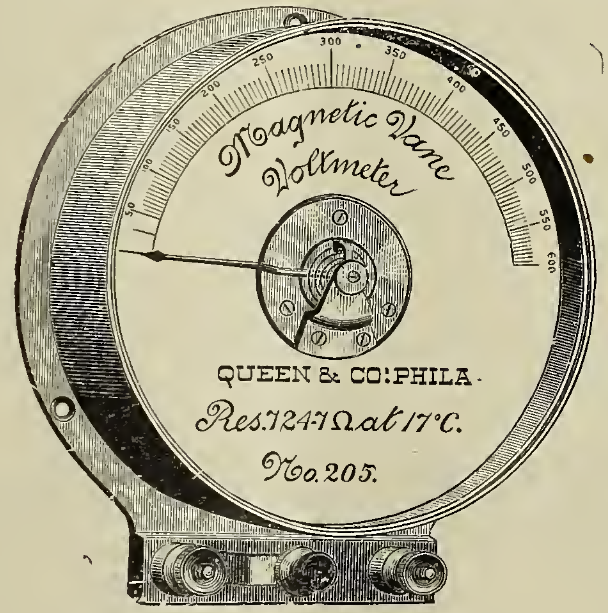
Great use of the standard cell has been made in test work of the finest kind. This is simply a very well made primary cell of constant E.M.F. at a certain temperature. The two generally known in laboratory practice are the Clark and Carhart cell. The deflection obtained on a galvanometer with one of these and a fixed resistance and shunt can, by comparison, be made the basis for further calculations with greater pressures under the same conditions.

Weston Voltmeter.—A voltmeter of well-known make is that invented by Edward Weston. It is built upon the principle of the D'Arsonval galvanometer, and for accuracy and reliability stands unequalled. It is inherently a galvanometer, but of so practical a construction that in spite of its delicacy it can suffer rough usage before becoming injured to a perceptible degree.

It is to be remembered that the ordinary type of galvanometer consists of a fixed coil and a movable magnetized needle. In the above instrument, however, these conditions are reversed. Instead of a small magnetic needle subject to the influence of a thousand disturbances, there is a heavy steel horseshoe magnet whose extremities are hollowed out to receive a small coil of fine wire mounted on pivots. Two watch-springs convey the current to the coil, one being connected to each end of it, though insulated from each other. The current after traversing this coil passes through a series of finely-wound reels of german silver wire of exceedingly high resistance.

The metallic drum around which the coil rotates prevents any unsettled swing, thus rendering it *dead beat.* The magnet is rigid in this instrument, and the coil swings freely in contradistinction to the last and more familiar style of ordinary galvanometer.

A pressure can be measured by a system of comparison, as follows: A known high resistance is connected between two points, the difference of potential between which is to be measured. A standard cell and galvanometer are then connected to it so that their respective currents tend to flow in opposition. When a point in the high resistance is reached at which no deflection takes place, the pressure from the cell and the difference of potential between the extremities of that portion of the high resistance balance. Supposing the standard cell to be two volts and the resistance creating this equilibrium between its ends twenty ohms, there will then be as many times two volts in the wire as twenty ohms are contained in its entire resistance. Were the entire resistance of the wire one thousand ohms, the difference of potential existing between its ends would be one hundred volts.



Magnetic Vane Voltmeter.

Drop of potential is ascertained in a very simple manner worthy of notice.

When a known current is passed through a wire of known resistance, the fall of pressure throughout the wire can be at once calculated by the rule:

Drop of potential = current $\times$ resistance. The pressure at one end of the wire will vary from that of the other end by that difference. In order to make this method of avail, an ammeter must be used and the resistance of the wire carefully determined.

In shop practice, where an ammeter is the only accessible instrument, a definite number of feet of copper wire will use up a pressure that is not great. The resistance of the wire per thousand feet is given in catalogues of wire manufacturers. The current passing through it will complete the data necessary, and the calculation can be made

with 1,000 feet No. 10 wire = 1 ohm,
with 30 amperes flowing.

$$\text{Drop of potential} = 1 \times 30 = 30 \text{ volts.}$$

Many interesting problems arise from a study of the

drop of potential in a wire. The system of subway distribution, the network of circuits to be supplied to a house, are all built upon the basis of a certain estimated drop from point to point. And the illumination within depends entirely upon the care with which such considerations are made.

Thus the methods above outlined contain the essential principles depended upon for any reliable result in the measurement of pressure.

Electromotive force and difference of potential differ in this respect from each other. The inherent cause of electrical phenomena is due to the presence of a current or charge, but an electromotive force has given rise to the current by establishing a difference of potential between two points, thus allowing a flow of electricity to occur when the circuit is completed. In a cell of battery there are electromotive forces at work within the cell creating a difference of potential outside, by whose means a current can flow if permitted.

Thus electromotive force may be looked upon as the prime cause from which follow the subsequent effects of difference of potential and a current of electricity.

The volt is a unit of pressure. It will send a current of one ampere through a resistance of one ohm.

It is defined in other ways by reference to a magnetic system. *The unit of electromotive force is that which is created in a conductor moving through a magnetic field at such a rate as to cut one unit line per second.*

This definition has practically been adopted by all as the basis of the volt. The volt, such as considered in practice as a unit, would be equal to that electromotive force generated within a conductor cutting 100,000,000 lines of force per second.

Some molecular action within a wire sets up a disturbance whose effects are heat, magnetism and electricity; when the agitation becomes extreme, the heat accumulates with too great a rapidity for instant radiation and the phenomenon of light appears in all its gradations. The original cause of such effects is an electromotive force free to display its activity in so striking a manner.

effect, a temperature of 100 degrees Fahrenheit must be maintained for five and a half minutes. The effect on the skin is powerful. The elimination of carbonic acid is put at an average of five per cent., while with the Turkish bath, the highest percentage is 4.07, and with the Russian bath 3.96. The interior of the bath is, as may be expected, dazzling in its brilliancy. The sides, ceiling and floor of the cabinet are constructed entirely of mirrors. Rows of lamps run perpendicularly and horizontally, making a framework of light, which is reflected a thousand times in the innumerable mirrored facets with which the cabinet is studded. In the centre is a couch, upon which the patient reclines. It is so constructed that the whole of the body of the patient can be at the same time exposed to the influence of the radiant light and heat. The instrument for denoting the play of the vital forces, called the biometer, is said to have been discovered in France by Dr. Barraduc. The impulses of the body are supposed to be indicated by the movement of a needle. According to a description which has been given of the operation of this instrument, when a man is in perfect health, the current induced within it plays from right to left, the right hand attracting the needle about 15 degrees, while the left repels it an equal distance. When a man is under the strain of prolonged physical or intellectual work both hands repel the needle; there is a loss of vital force, which is shown by fatigue. During sleep, convalescence and rest both hands attract the needle. Very often the waste of vital force continues long after the physical or cerebral effort is over, to the great detriment of the body. There is a "flight" of vital forces, which is quite as depressing in its way as an actual loss of blood. Dr. Barraduc finds that the most effective way of repairing this serious loss and restoring the vital equilibrium is to shut himself up in an electro-luminous bath for a few minutes. This bath of light, he says, fills his head with life-giving warmth, and within an hour he is enjoying a quiet and recuperating rest. After this rest, the indications of the biometer become normal.—St. Louis Globe-Democrat.

Samples of Holophanes.

Bathing in Electric Light.—The efficacy of the electric light bath would appear to have received some confirmation in connection with the reputed discovery of an instrument for measuring the vital force of the human organism. The luminous bath has long been known as the pet scheme of a progressive electrotherapist in this country. He says he can get better results by bathing his patients in light than in simply hot air, and perspiration is induced very quickly. The light bath makes the patient perspire in four minutes at a temperature of 80 Fahrenheit, whereas in the Turkish bath, to produce the same

HOLOPHANES.

Mr. Reinhard Schmitt, the well-known manager of the Boudreaux Dynamo Supply Co., of 253 Broadway, has taken the Eastern agency for the "Holophane" globes. These globes are the invention of Messrs. Blondel & Psaroudaki, of Paris, and have attracted the attention of the scientific world. They are made of clear flint glass, having external and internal ribs and flutings, the forms of which have been so calculated that they give the most advantageous distribution and perfect diffusion of

the rays from the various light sources. The Holophane is the only globe giving the soft and pleasing effect of perfectly diffused light without decreasing the efficiency, as in the case of opal or ground glass shades. The entire surface of the globe shines with a sparkling but not dazzling light, and is far more beautiful than the most expensive cut glass. It is impossible to give an adequate description of their beauty and utility; they must be seen to be understood.

Mr. Schmitt has fitted up an exhibition room in the Postal Telegraph building, where these remarkable globes may be seen. The name of the manufacturers, the Geo. A. Macbeth Co., of Pittsburg, of "Pearl glass" fame, is a sufficient guarantee of the mechanical excellence of the "Holophane" globes.

(Q.)—BEST WOOD FOR POLES.

San Antonio, Dec. 22, 1896.

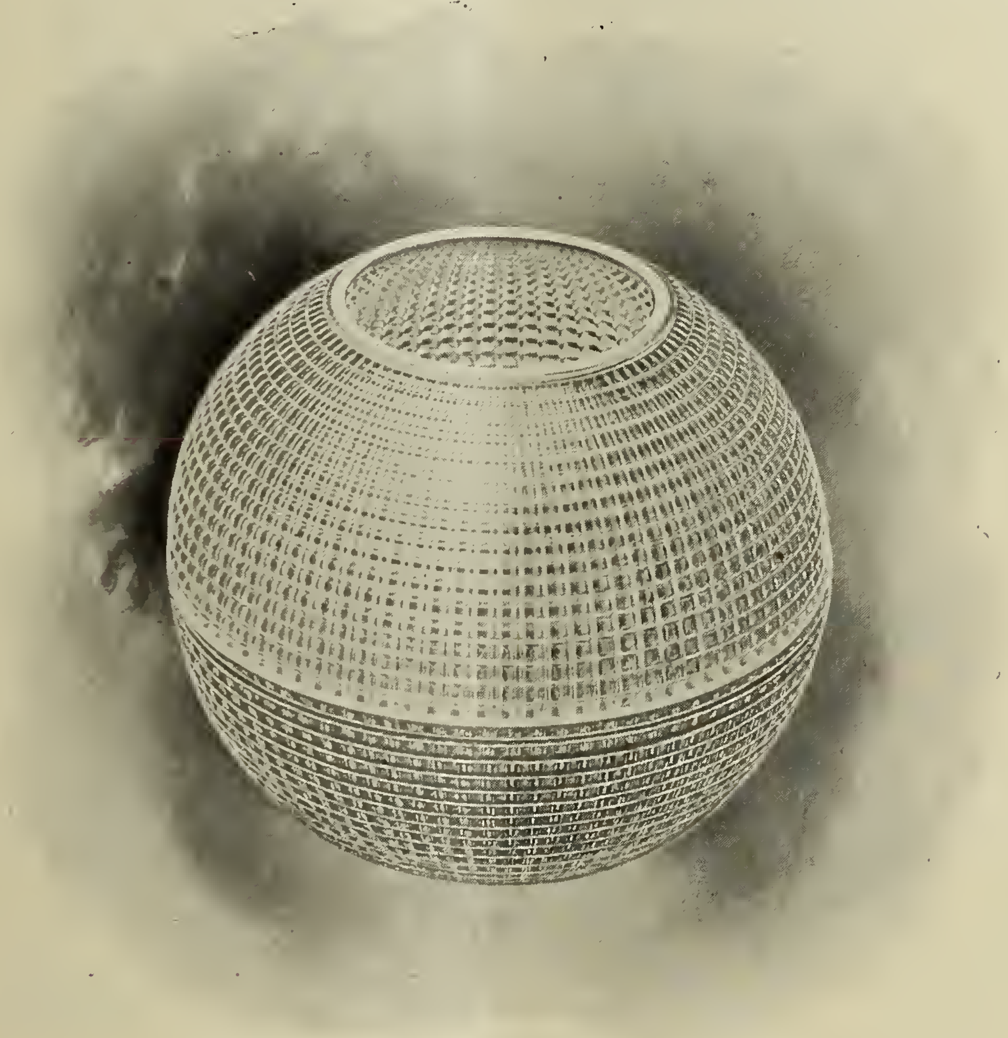
Electrical Age.

Dear Sir:—Your very useful Inquiry Column has been of much consequence to me in my daily work. At present I am erecting a new line and do not know what kind of wood to choose for poles. The labor here is native and not very dear. Kindly inform me as speedily as possible.

Yours truly,

John Rossel.

(A.)—For the construction of telegraph lines the best wood is the least absorbent and least hygroscopic. Select timber of this nature and, if possible, saturate the end that enters the ground in tar or creosote. Poles decay quickly in southern climates, unless given the best of attention during installation.



The Holophane.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q) —ETHER WAVES OR MATERIAL PARTICLES.

Boston, Jan. 2, 1897.

To the Editor.

Dear Sir:—In reading the different reviews concerning the nature of X rays, I have been surprised at the variety of opinions existing in regard to their nature. There seems to me to be at least one direction toward which all opinions should have their trend. The diversity of eligible theories amazes me. Can you in this little column point out at least the most reasonable opinion to hold?

Yours very truly,

Arthur Saucey.

(A.)—Two prominent theories exist possessing value and weight on the nature of X rays:

(1) Ether waves.

(2) Rapidly moving material particles.

The major portion of scientific evidence seems to bear out the opinion that X rays are ether waves, whose existence and characteristics are new and strange to us.

(Q.)—TELEPHONIC SPEECH.

Bangor, Dec. 15, 1896.

Electrical Age.

Dear Sir:—Your journal has afforded me much pleasure by its instructive contents and fund of information. I am led to use the Inquiry Column in my effort to discover why telephonic speech is not possible completely around the world. Kindly state the reasons, if any, why it is not.

Yours most respectfully,

Josiah Hampden.

(A.)—Telephonic speech around the earth is only limited by the conditions of the weather.

The longest line at present extends from New York to St. Louis, a distance of 1,400 miles. The reasons why telephony in any case is limited is, because the "self-induction" and "capacity" of the line are too great. With good insulation and a copper wire, the distance can be extended.

Byron, Mich.—An electric light plant will be erected in this city.

Mr. C. L. Warrick, of the firm of C. L. Warrick & Co., 136 Liberty street, New York, has lately returned from a successful trip throughout the Western States. He reports an excellent business outlook, with every sign of a growing and permanent prosperity. In evidence of this he brought home a good supply of orders and is naturally pleased with his trip. The Essex incandescent lamp, for which they have the sole agency, is earning a solid reputation for itself, as well as the arc lamps, snap and knife switches, Essex tape and other excellent specialties of this concern.

An energetic and wide-awake business man, who has been engaged in general electrical engineering and contracting, and also has many of the well-known specialties of the trade, desires the agency for some new and quick-selling articles. Address, T. L., care of "Electrical Age," World Building, N. Y.

Bainbridge, Ga.—The establishment of an electric light plant is contemplated by S. Nussbaum.

Culpepper, Va.—Jeffries Brothers can give information about the construction of an ice plant and electric plant which is being talked of.

Lookout Mountain, Tenn.—The electric plant of the Lookout Mountain and Lulu Lake Incline Railway Co. has been destroyed by fire.

New Orleans, La.—The Great Southern Telephone and Telegraph Co. has obtained a permit for the construction of a $25,000 office building.

San Antonio, Tex.—Chicago capitalists have about decided to build a $300,000 hotel in San Antonio. Jules de Horvath, of Chicago, has completed preliminary plans for the proposed structure, a building of steel construction, eight stories high; passenger and freight elevators, electric fixtures, etc.

Knoxville, Tenn.—About $15,000 will be expended by the East Tennessee Telephone Co. in improving and extending its Knoxville lines and plant.

Truro, N. S.—The Chambers Electric Light and Power Co., of Truro, has received a 1,200-light dynamo from Connecticut recently, and have installed a 175-H.P. side-crack engine from the Robb Engineering Co.

Embro, Ont.—Embro is to have incandescent lights. The Canadian General Electric Company has the contract for a 500-light alternating plant.

James Braid, chief of the electrical department of the Tennessee Centennial Exposition, is in town.

The Prudential Insurance Co. of America,
Home Office, 761–769 Broad Street.
Newark, N. J., Oct. 13, 1896.

W. H. Fleming, Esq.

Dear Sir:—In answer to your inquiry of Sept. 30, as to the 12 gauze wire brushes purchased by us from you and put in use on our dynamos Feb. 25, 1894, would say that they are still in daily use, having worn down about 1¼ inch. As to our commutators, our No. 2 ran one year without having a piece of sand-paper or other grinding material put to it, and all of them are in good shape.

I remain very respectfully,

Geo. A. Warren, Chief Engineer.

Size of brush, 1¾ x 5-16 x 8 inches. Dynamos run 16½ hours daily continuously.

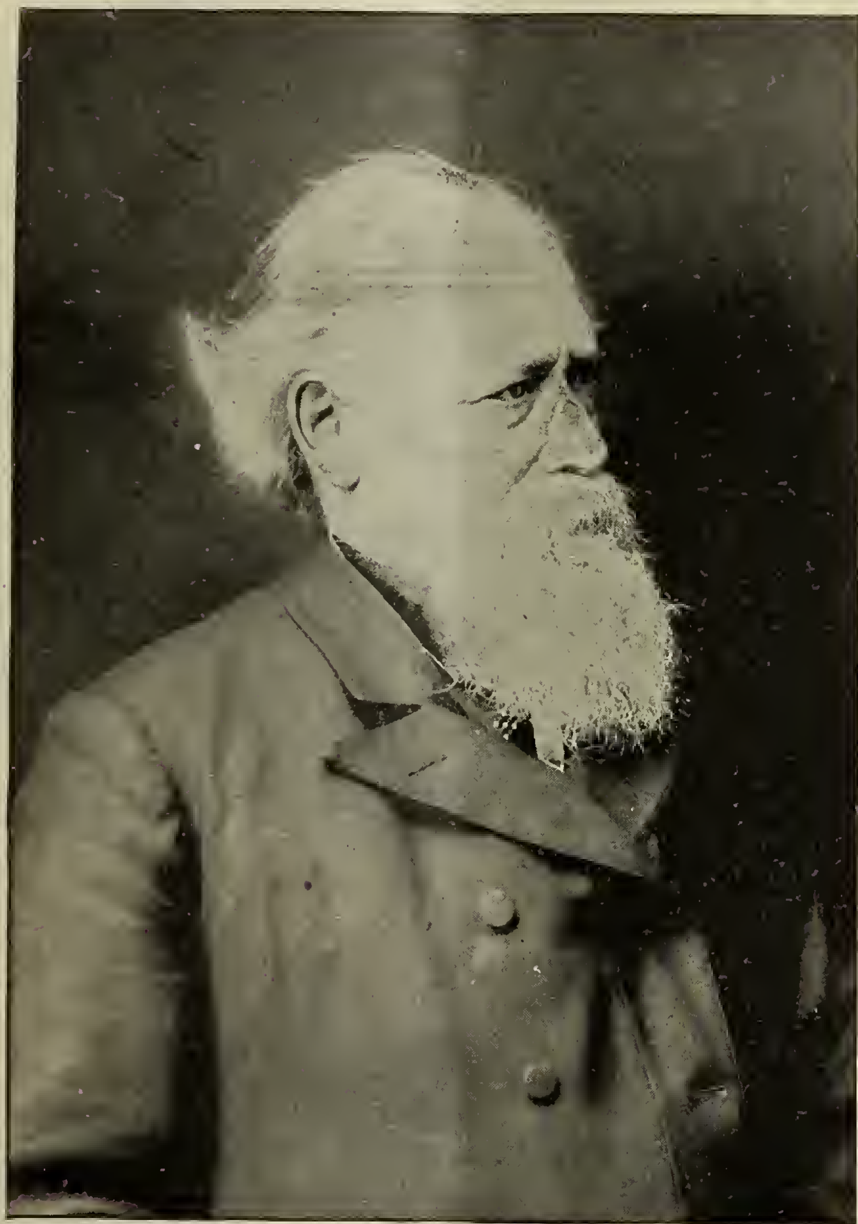
Very truly yours,
STANLEY & PATTERSON,
Sole Selling Agents for the U. S.
32-34 Frankfort St., N. Y.

ELECTRIC STOCK QUOTATIONS.

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	35	38
Edison Illg. Co. (St. Louis),	10	17
Eddy Electric Mfg. Company,	—	19
Edison Elec. Illg. Co., New York,	102½	103½
Edison Elec. Illg. Co., Brooklyn,	97	99
Edison Ore Milling Co.,	7	10
Edison Elec. Storage Company,	28	29
East End Electric Light Co.,	—	—
Fort Wayne Electric Company,	3	3½
Ft. Wayne Elec. Co. T. Sec. Series A,	3	4
General Electric Company,	33	33¾
General Electric Company pf.,	75	76½
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	81½	82
Rhode Island Elec. Protec. Co.,	110	122
Toronto (Canada) Elec. Light Co.,	126	133
T.-H. Elec. Co., T. Secur., Series D,	3½	4¼
Thomson-Houston Welding Co.,	5	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse El. & Mfg. Co., pf.,	50	51½
Westinghouse El. & Mfg. Co., assd.,	23	24

The Electrical Age.

VOL. XIX., No. 3. NEW YORK, JANUARY 16, 1897. WHOLE No. 505



F. M. F. CAZIN,

The Discoverer of the Natural Law, by which Resistance to Motion in a Medium is Measured.

(*The Journal of the Franklin Institute, March to May, 1893.*)

AN IMPORTANT NATURAL LAW

RELATING TO HYDRAULICS, NAUTICS AND AERONAUTICS,

Newly Discovered by F. M. F. Cazin.

Compare: The Journal of the Franklin Institute, March to May, 1893, and July, 1894.

A solid, when moving in a medium, causes a stated uantity of the medium to move in a direction inverse to he movement of the solid; and this quantity of the meium moved inversely is as the product of the volume isplaced by first immersion, by the distance of travel, ivided by the length of the solid, such length being easured in the direction of relative motion, and the istance, for which this stated quantity of the medium is oved inversely, is as the length of the solid, measured the direction of relative motion.

By introducing into theoretical mechanics the (also) ew value

$$\frac{B}{d} = \frac{\text{Buoyancy}}{\text{Length}}$$

or "transverse average section," this newly discovered w was made serviceable for measuring the resistances motion of ship, and the theoretical power required for ropelling her. And it was shown that aside of the quantity of the medium permanently and inversely moved by the movement of ship, another stated quantity* of the medium is moved by the motion of ship, such other quantity returning to the position previously occupied without exercising any resistance or increasing power-requirement.

The resistance to motion of ship, and to motion of a solid in a medium in general, was shown to be correctly expressed by

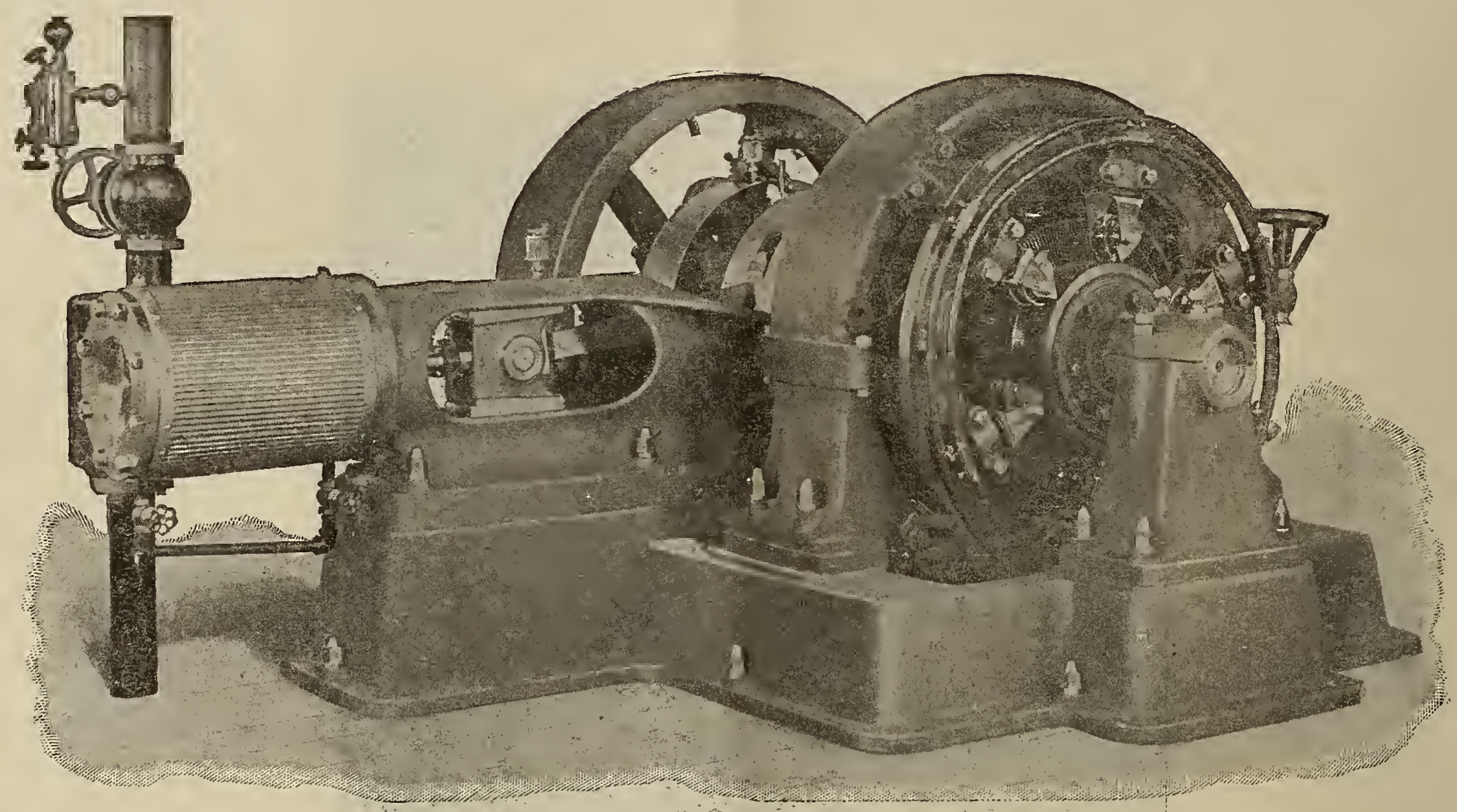
$$R = y \,.\, \frac{B}{d} \,.\, v \times \frac{v^2}{2g} \text{ kgm — ms.}$$

B signifying buoyancy or displacement by first immersion in cubic metres.

* This quantity is the product of the length of travel by the difference between the transverse major section of the solid and its transverse average section, which latter is as the immersed volume divided by its length, such length being measured in the direction of relative movement.

d signifying length of solid, measured in the direction of relative motion, in metres.

v signifying velocity per second, in metres.

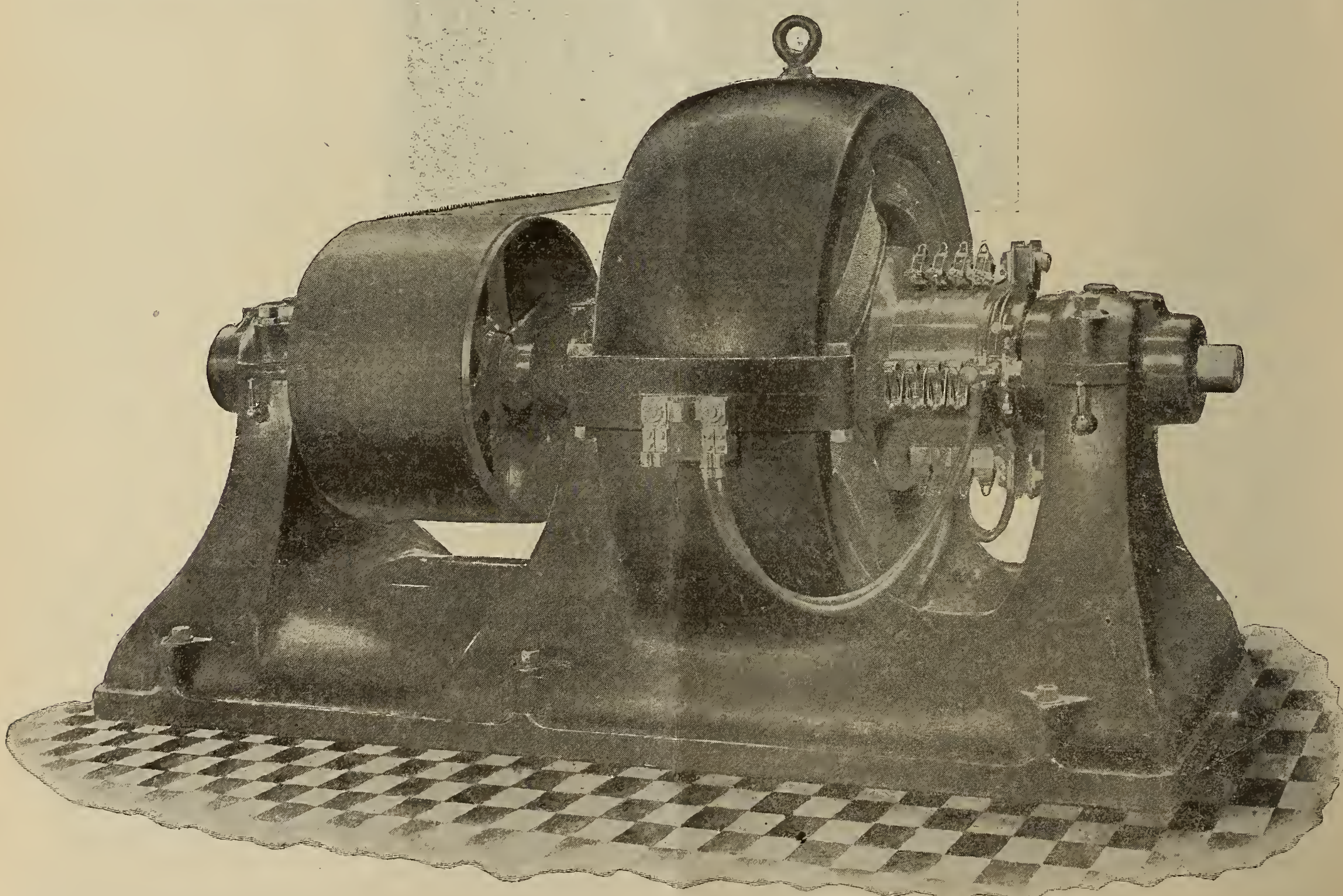


Walker Generator Direct Connected.

y, relating to the movement in water, signifying 1,000, as changing cubic metres or metric tons, in which the value B would otherwise appear, into kilograms, and in consequence the total value into kilogram metres, all values for distance, area or volume being expressed in metres.

For other media than water the concrete value for y is the product of 1,000 by the density of the medium relative to water.

And from the equation for resistance to motion in a medium, other important equations were evolved, by which the speed of a solid falling in any medium whatever is measured. The final speed of such fall is as



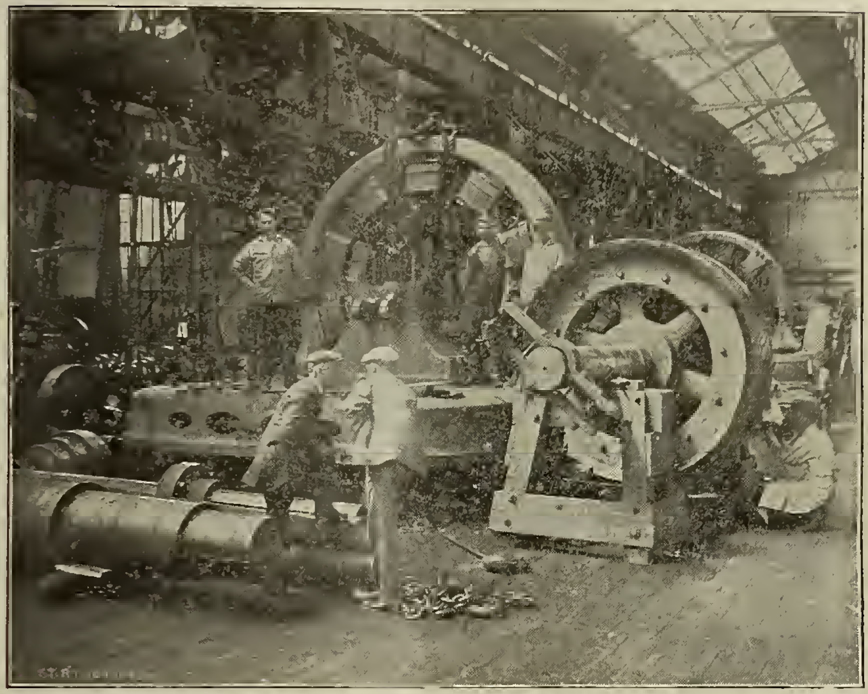
Walker Lightning Generator.

$$C = \sqrt{2 \cdot g \cdot d \cdot \delta \cdot \frac{\delta - 1}{\delta + 1}}$$

δ signifying the density of the falling solid, relative to the medium in which it falls.

But previous to falling with the final and maximum velocity, all solids fall a certain distance in a medium with a modified acceleration

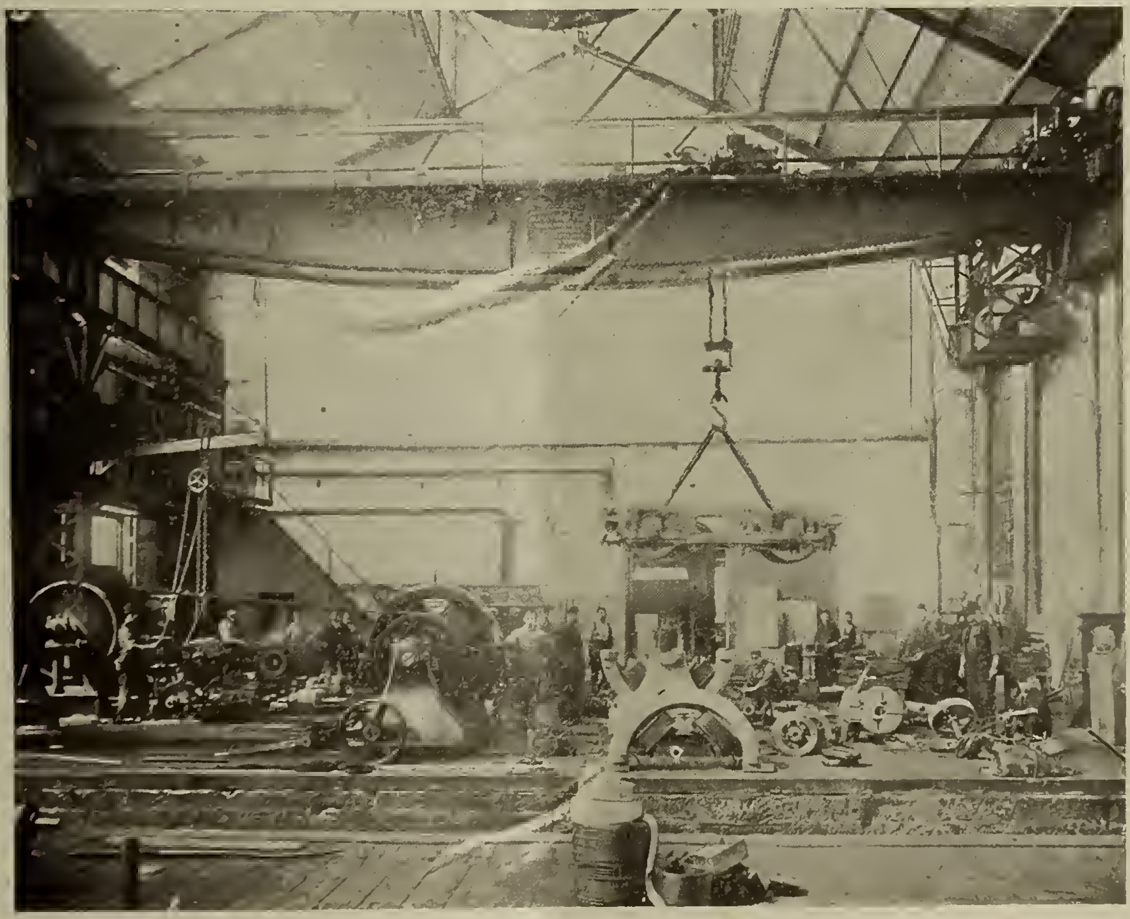
$$= g \frac{\delta - 1}{\delta + 1}$$



Assembling Department, Cleveland Department.

(if, on account of higher density, it falls at all), and such distance of primary fall is

$$= d \,.\, \delta$$



Testing Room.

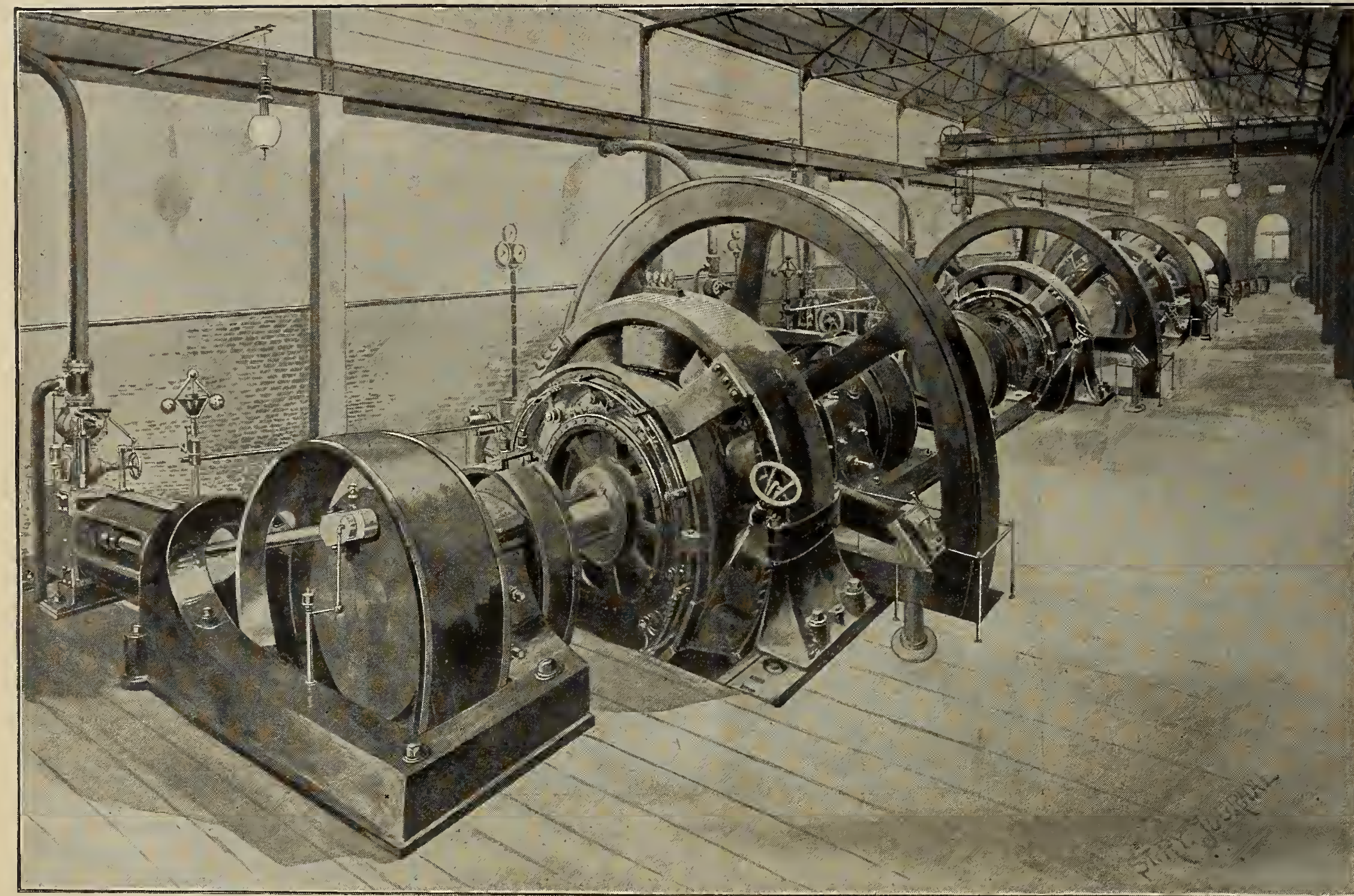
this is the distance, within which it causes to move inversely (this is to ascend) its own weight of the medium for the distance of its own length, and the aggregate velocity with which this limited distance is passed is only one-half of the ultimate *uniform* velocity of submerged fall, or

$$\frac{v}{2} = \frac{C}{2} = \frac{\sqrt{2 g \,.\, d \,.\, \delta \,.\, \frac{\delta - 1}{\delta + 1}}}{2}$$

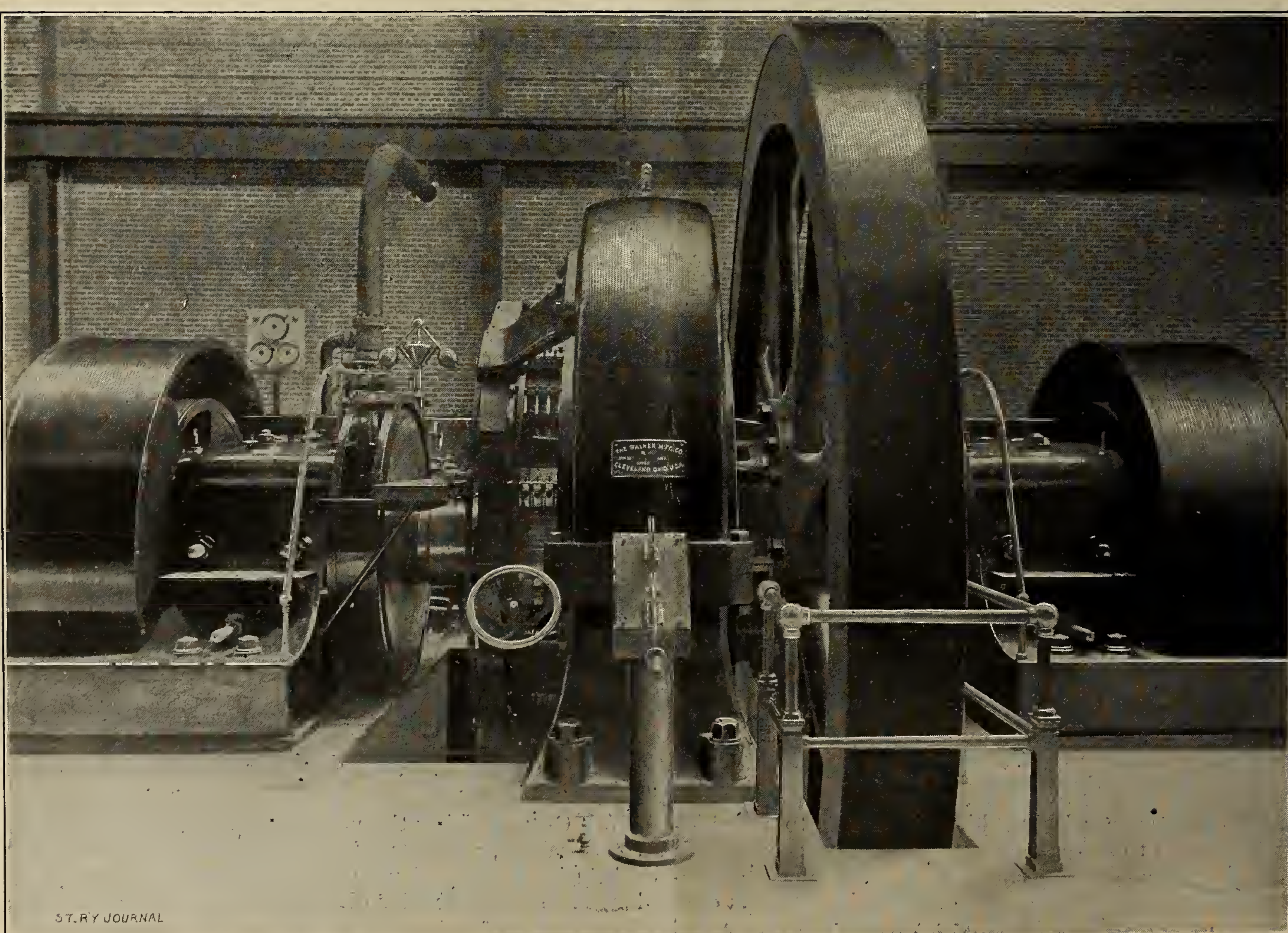
such ultimate uniform velocity of submerged fall being conditioned—

(1) By the solid's form, being closely adapted in its longitudinal lines to the molecular division lines of the medium;

(2) On modifying the value d to the real length of the moving form, whether solid or in part of the medium itself, on account of nature itself adapting the moving length to the molecular division lines of the medium.



The Walker Generators at Detroit.



Direct Connected 800 K. W. Railway Generator.

A GREAT MODERN INDUSTRY.

The nervous energy displayed by the average American citizen is such that it characterizes him above all others as unique, both in effort and the application of his abilities in a practical and progressive manner.

Perhaps no concern represents this tendency more strikingly than the Walker Co.

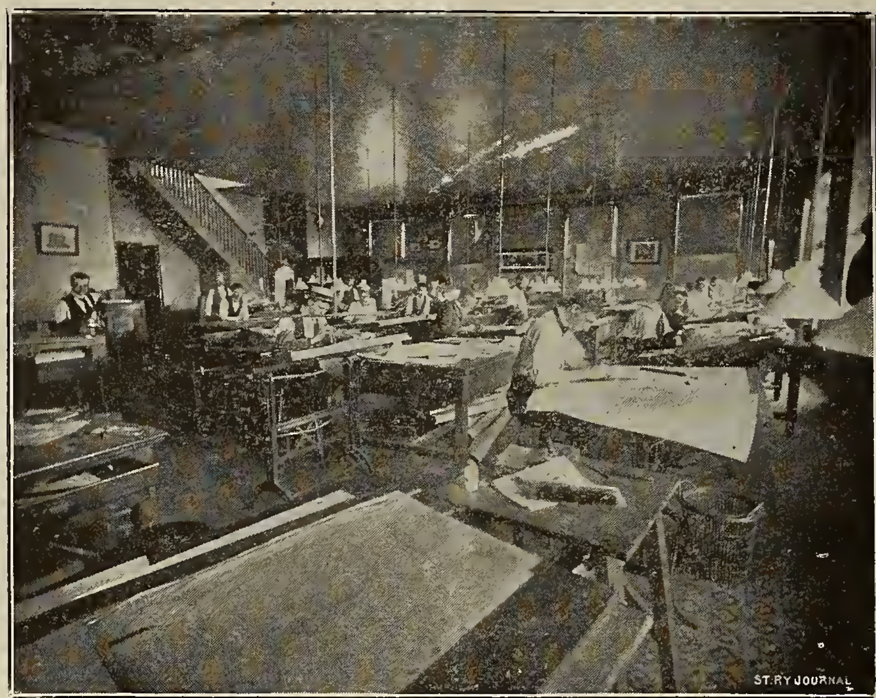
The company's principal factory is located at Cleveland, O. It covers twelve acres of ground and is devoted almost exclusively to dynamo and motor works. Its foundry, lathes, planers and special tools are capable of handling the largest sizes of castings, and some of its planers are able to carry, for example, a complete 800-k. w. generator assembled, weighing 170,000 pounds. The Cleveland shops, exclusive of the further extensions

New Haven Factory.

New Haven Factory.

Insulating Department.

now planned, have a capacity for turning out about 200,000 h. p. of railway and lighting generators, 75,000 h. p. of motors, and 15,000 h. p. of arc lighting generators per annum.



Draughting Room.

A general idea of the extent and facilities of the Cleveland works can be gained from a glance at the accompanying cuts. The views of the interior of the works demonstrate the enormous amount of work that is now being carried on, and the necessity of increase of even these magnificent facilities.

800 K. W. Rope-Driven Railway Generator.

Besides the extensive plant at Cleveland, the company has acquired a large factory at New Haven for the manufacture of switchboards and all of the smaller accessories of railway and lighting equipments. Views of these works are submitted in the four accompanying cuts.

The idea that dynamos and other types of electrical machinery are not reliable, but likely to become inoperative at the least sign of trouble, is gradually being swept aside as false and totally incorrect. Nothing is perhaps better prepared, in the line of machinery, to stand the strains of overload or the hammer and bang of daily

(Continued on Page 40.)

The Electrical Age.

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CONTENTS.

HIGH PRESSURES OVER GREAT DISTANCES.

The present disposition on the part of engineers is to try and extend as far as possible the distance over which power can be transmitted.

There is in the history of all efforts of this kind a certain amount of interest. The gradual unfolding of the petals of a flower could not be a more fascinating study to the botanist than the development of so remarkable a field of engineering as the transmission of power.

Since Marcel Deprex, of France, assumed the initiative on this subject and practically demonstrated the possibility of sending electrical energy between points widely separated, a host of experiments have been made of a similar nature.

The following list, compiled by Mr. Louis Duncan, shows the extent and character of the systems installed:

It is not a harsh criticism of practical work to say that, until within a few years ago, the subject of electric power transmission could be contained within the limits of a purely experimental field. The great demonstration at the last German Fair illustrates the successful transmission of 300-horse power between Frankfort and Lauffen, a distance of 100 miles, at a pressure of 30,000 volts.

This and a series of other installations show conclusively that the difficulties confronting the engineer are only successfully coped with by using a high pressure and an alternating current. There was a time when considerable doubt was expressed as to the proper system to employ; but practice has definitely decided the matter, and an alternating, high-pressure, multiphase system is undoubtedly the one at present popularly prevalent.

Andrew P. Tallmadge and Henry C. Wilson, two electricians of this city, started yesterday with Congressman John J. Gardner, of New Jersey, for the purpose of establishing an electric plant on his farm near Egg Harbor City, a short distance from Atlantic City. An electrical generating apparatus will be installed near Mr. Gardner's dwelling to furnish power for lighting, pumping, woodsawing, feed-cutting, thrashing, etc. A portable truck motor will also be one of the features of equipment. Mr. Gardner, in connection with his large berry farm, operates an extensive canning plant, so that this electric power will also contribute to the economical working of that branch of the business.—Washington Post.

NAME.	TYPE.	Distance in Miles.	Line Voltage.	Horse Power	REMARKS.
Ouray, Col	Direct.	4	800	1,200	Successful, increasing.
Geneva, Switzerland	"	20	6,600	400	Successful.
San Francisco, Cal	"	12	8,000	1,000	Successful, 9 years.
Brescia	"	12	15,000	700	
Pomona & San Bernardino	Sing. ph. alt	13½ to 28¾	1,000	800	Successful, inc., 4 years.
Telluride, Col	"	3	3,000	400	To be inc., 3,200 H. P.
Bodie, Col	"	12½	3,400	160	Successful.
Rome, Italy	"	18	6,000	2,000	Increasing to 9,000 H. P., 3 years.
Davos, Switzerland	"	2	3,660	600	Successful.
Schongeisung, Germany	"	4½	2,600	820	Successful.
Springfield, Mass	2-phase alt.	6½	3,600	820	Successful.
Quebec, Canada	"	8	5,000	2,130	Successful.
Anderson, S. C	"	8	5,500	200	Successful.
Fitchburg, Mass	"	2¼	2,150	400	Successful.
Winooski, Vt	3-phase.	2½	2,500	150	Successful.
Baltic, Conn	"	5	2,500	700	Successful.
St. Hyacinthe, Canada	"	5	2,500	600	Successful, 2 years.
Concord, N. H	"	4	2,500	5,000	Successful, 2 years.
Fresno, Cal	"	35	11,000	1,400	To be increased.
Big Cottonwood to Salt Lake City, Utah	"	14	10,000	1,400	Successful.
Lowell, Mass	"	6 to 15	5,500	480	Successful.
Sacramento-Folsom, Cal	"	24	10,000	4,000	1 year.
Redlands, Cal	"	7½	2,500	700	3 years extending lines in other towns.
Lauffen to Frankfort, Germany	"	100	30,000	300	(Experimental.)
Oerlikon to Heilbroun, Germany	"	9	5,000	600	Successful.
Oerlikon Works, Zurich, Switzerland	"	15½	13,000	450	Successful.
Portland, Ore	"	12	6,000	5,000	Successful.
Silverton Mine, Col	"	4	2,500	400	Successful, to be inc.

practice than the modern generator. The Walker Company have wisely departed from the old paths of tradition, and in beginning their work on all occasions have not failed to consider it of as positive and legitimate a nature as the construction of the mightiest Corliss engine ever made.

Dynamos and motors have now been built in this country and abroad for about fifty years. The principles and details of their construction have long been well understood by scientists and manufacturers. There are no valid patents whatever which prevent any company from constructing such machines substantially in any form desired.

The Walker direct-connected generators for railway service are of the multipolar type, the number of poles varying from six in the smaller sizes to fourteen in the huge 1,600-k. w. (2,150 h.-p.) generator.

The mistake of providing too little iron and copper for the rated horse-power of generators is too often made by manufacturers, and the Walker Company has preferred to be liberal in its use of iron and copper, to the end of building machines which will run at high efficiency throughout the range of their rated power, and which will have a large reserve power to be called upon in case of emergency. For example, before the installation of the four Walker 800-k. w. generators in the Detroit Railway Company's power station, the railway company was trying to do a very large business with two 400-k. w. Walker generators, and on several occasions it ran these machines for upwards of ten hours with a fifty per cent. overload without the slightest sparking or other injurious effect in any part of the machine. In fact, on one occasion each machine was forced to carry 1,400 amperes for four hours at the time of a heavy snow-storm, the rated output being 725 amperes. At that time the current was so excessive that the insulation of the 1,500,000 c. m. cables running from the generators to the switchboard was melted.

From the appended cuts, illustrating general appearance and detail of the Walker generators, an idea can be gained of their thoroughness of construction.

The material and workmanship incorporated into these machines is of the very highest grade. The commutator bars are of drop forged copper, the armature conductors of carefully selected rolled copper ribbon, and the insulation is of the purest India mica. There are no soldered joints in the coils, and every bend made in this member is carefully inspected before taping. This precludes the possibility of incipient cracks, which so often pass unnoticed in armatures where the insulated conductor is formed.

The Walker Co. have paid great attention to machines for electric lighting. The common complaint that the lighting machine deteriorates more rapidly than the heavier railway generator is in many cases true, but experience has shown clearly that haste in construction, poverty of design or a general carelessness in assembling is apt to produce a series of local faults in a dynamo that eventually cause a degeneration that is rapid and complete.

The company have realized in full that discrepancies such as these exist because of a lack of hard knocks in the beginning. The manufacture of railway apparatus calls for the highest skill and forethought. The direction of an experience gained in the manufacture of this machinery to the designed construction of lighting generators naturally represents a step from a higher to a slightly lower but not less elaborate class of work.

The result of this practice has been to gain for the Walker lighting generators a great reputation for durability and excess load capacity. In a railway power station where there is ample and expert attendance, a dynamo that sparks at every change of load *can* be tolerated, although it is a great source of expense and annoyance. In an isolated plant, however, where the attendance is limited, and often ignorant, careless, or both, a sparkless machine is absolutely necessary to prevent periodic renewal of the commutator. The Walker railway generators have become famous on account of their non-sparking qualities, and the lighting generators are in no wise inferior. With the Walker dynamo, the commutator lasts as long as the machine. These generators are supplied either as direct-connected units or arranged to be belt-driven, as the customer may prefer. The direct-connected generators are notably lower in speed than any of the competing makes of equal capacity.

The units of the electrical combine have occupied the field for many years. It is not strange that many of their machines have been sold and that they are doing a large business. But on the other hand, it is a matter worthy of some thought as to how the Walker Company have in three years placed upon the market a line of electrical apparatus and sold it in such quantity as to overtax productive facilities that outrival those of any of their competitors. There can only be one reason that has enabled the Walker Company to do in almost a day what has required years of labor on the part of its rivals. It is found in the superiority of the product, and the fair prices at which it is offered to the public.

Winding a Large Armature.

Baltimore, Md.—$1,000,000 will be appropriated for the city's proposed subway system. Plans for the same have been prepared by the engineer for the commission, N. S. Hill, Jr.

Interesting Facts in Science.

The Davy-Faraday Laboratory.—Dr. Mond's new laboratory at the Royal Institution will be open for research work after the 18th inst. The object of the laboratory is the promotion of original research in pure and physical chemistry, and under the deed of trust workers in the laboratory are entitled, free of charge, to gas, electricity, and water, as far as available, and, at the discretion of the directors, to the use of the apparatus belonging to the laboratory, together with such materials and chemicals as may be authorized. Any person desiring to use the laboratory for the purpose of conducting a research must send to the directors evidence of scientific training and previous experience in original research, along with a statement of the nature of the investigation he proposes to undertake. Application should be made in the first instance to the assistant secretary, Royal Institution, from whom further information on the subject of the purposes for which the laboratory is available will be forthcoming. The directors are Lord Rayleigh and Prof. Dewar, and the superintendent of the laboratory is Dr. Alexander Scott. As this is the only institution of the kind in existence, it may reasonably be anticipated that the directors will have somewhat of a task to decide between the applicants desiring to use the facilities offered. Should these prove very numerous, the position will be one of some delicacy, since not only are there no precedents to fall back upon, but there is the consciousness that, besides what is actually accomplished there, the working of the Davy-Faraday laboratory may have indirectly most important effeets on the future of science, since a few years of conspicuous success there would almost certainly serve to turn some portion of the stream of public beneficence into the direction of similar institutions and the much desired endowment of pure research.—Electric Engineer of London.

Farming by Electricity.—It appears that the application of electric power to agricultural purposes is being practically tried in the United States with favorable results. Experimental farms have been established, where nearly all the work has been performed by means of electricity, fields ploughed, harrowed, fertilized, and rolled, seeds planted and covered with soil, weeds killed, and crops harvested and threshed. It would, remarks the North American Review, be difficult to conceive the ultimate effect upon our industrial and economic life of the development of such an industry. The world's supply of bread-stuffs would be increased beyond the point of consumption, while the reduced prices and the cost of an electric plant would make it impossible for most of our present farmers to remain engaged in agriculture. The horse will be crowded out of his legitimate work in this field, as he has been on the city car lines. An experimental farm to show the use of electric power has been established in the West. The electricity is generated by a turbine wheel, which is turned by a small stream dammed up for the purpose, and the cost of the power is reduced to a minimum. Sufficient power is generated by the wheel to light the whole place, run the threshing machines, plough the fields, harvest the crops, and run motor bicycles or wagons anywhere within the limits of the farm. A large Western farm, consisting of thousands of acres, with a good stream of water flowing through it, could probably be now conducted on a cheaper scale by electricity than by steam. In fact, the owners of some of the large farms are eagerly watching the development of electric locomotion, and as soon as experiments justify their actions, the steam plough, reaper, threshers and rakes will be supplanted by those run by electricity.—Yarmouth Times.

Johnson City, Tenn.—A good 200-light dynamo is wanted by the Jonesboro Cotton Mills.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—AN AMPERE TURN.

Toledo, Jan. 4, 1897.

Electrical Age Pub. Co.:

Dear Sirs:—The technical significance of the term ampere turn has bothered me to a considerable extent. Kindly let me know whether it expresses a given amount of magnetism, or if it is merely used as a phrase in science?

Yours respectfully,
Robert Carrol.

(A.)—An "ampere turn" or ampere turns measure the magnetizing force applied in any given case. The magnetizing force derived from an ampere turn is always the same, whatever its size may be.

From two turns carrying one-half an ampere, or four turns carrying one-quarter of an ampere, etc., we obtain the equivalent of one ampere turn. The expression $4 \pi n c$, where $n c$ represents ampere turns, gives a value to the magneto-motive force or magnetic energizing power of a coil.

(Q.)—FLASHING AT COMMUTATOR.

Red Bank, Jan. 5, 1897.

To the Editor:

Dear Sir:—I have been having some trouble with a dynamo lately that sparks very freely at the brushes. Not having had the experience or training required, I am not at present able to explain this difficulty. By publishing this in your Inquiry Column, with the answer beneath, you will greatly oblige a constant reader.

Yours truly.
Albert Hough.

(A.)—Sparking at the commutator is the direct result of either one or many of a series of troubles. The brushes may be out of line, the commutator have a loose connection; armature reaction may be very severe. By trying to set the brushes in line and moving them to the neutral point, the sparking may entirely disappear.

(Q.)—BEST PLANT TO INSTALL.

Miamisburg, Dec. 30, 1896.

Dear Sirs:—The questions you have answered have been read with the deepest interest by me. I shall only call upon you for an answer to this question:

How shall the nature of a lighting plant be determined in any locality? Must an arc, incandescent, continuous or alternating plant always be installed under certain circumstances, or is it merely a matter of opinion? For your expected kindness I remain,

Yours respectfully,
Benjamin Lionne.

(A.)—The question you ask demands considerable analysis. For bunched districts low tension, continuous is best. For long distance, arc or incandescent lighting; over scattered and straggling districts, high tension and alternating is commonly used. If capital is limited the rules are sometimes departed from.

(Q.)—USE OF STORAGE BATTERIES.

Toledo, Dec. 27, 1896.

Electrical Age Publishing Co.

Dear Sir:—Can you tell me why there is not a more popular use of storage batteries at the present day?

The objections to them have been greatly removed and I think in many cases they would prove a great help. I do not quite understand their use in central stations. Are they charged at *heavy* load and discharged when the sta-

tion has a light load, or are they charged at light load and *discharged* when the station has a heavy lood?

Yours respectfully,
Emil Gross.

(A.)—Storage batteries are now in a high state of perfection, being reliable and substantially made. They are used in stations as follows: Charged when the load is light and discharged when the station is becoming heavily loaded or very light. If a station is apt to be overloaded their use is almost indispensable, unless more dynamos are installed.

WALDORF'S HUGE ELECTRIC PLANT.

Poughkeepsie, Jan. 4.—John Jacob Astor, who lives at Rhinebeck, near here, has made a contract with the Walker Company for an electric plant for the new Astor Hotel, in Fifth avenue, New York City. The apparatus in the present Waldorf will be taken out and a new plant installed suitable for doing everything necessary in the enlarged hotel, which will be more than double its present size. The Waldorf system will be the largest isolated plant in the world. It will run easily 25,000 lights, and when pushed it will be able to develop 50,000 lights, or enough for a small city.

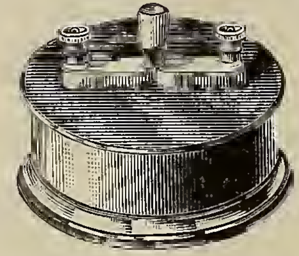
Those principally interested in the Walker Company are ex-Governor Flower, J. W. Hinkley, Perry Belmont, Anthony N. Brady, of New York; Dallas Sanders, of Philadelphia, and several Boston capitalists, together with S. E. Williamson and Jacob B. Perkins, of Cleveland.—N. Y. Tribune.

MEASUREMENT OF CAPACITY.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

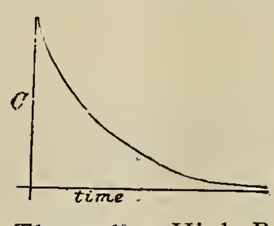
BY NEWTON HARRISON, E. E.

One of the most curious phenomenon is that of the charge and discharge of a Leyden jar. Under certain conditions a body, especially if it be made of metal,



Laboratory Condenser.

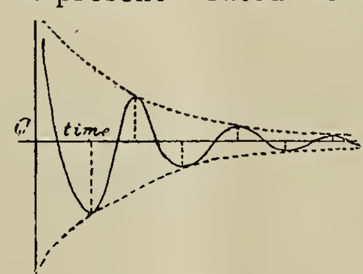
possesses the power of absorbing a charge of electricity. The quantity of electricity it retains in any given case is entirely dependent upon the surroundings. An ordinary sphere of brass exercises an inductive effect upon all objects around it. When the adjacent objects are placed in



Discharge Through a High Resistance.

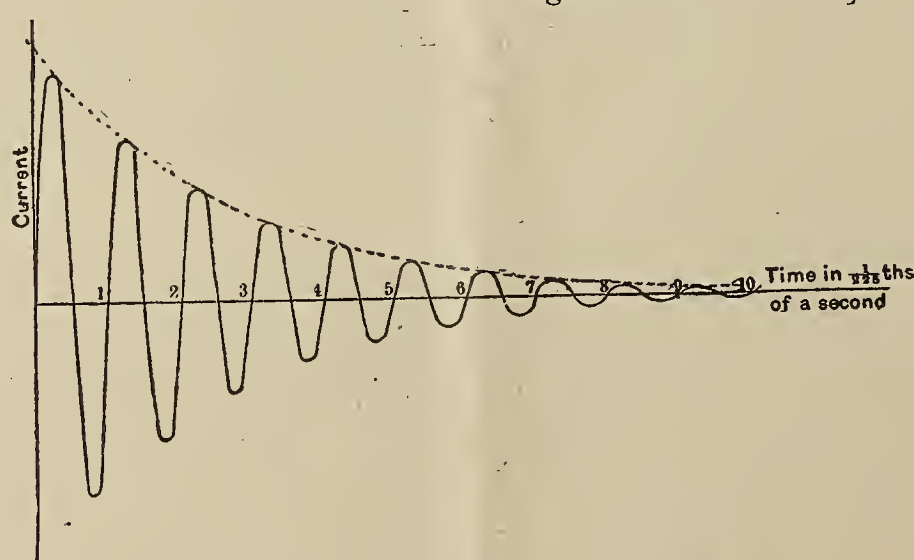
nearer proximity, the ability of the brass sphere to absorb a greater charge increases.

A Leyden jar is simply a pair of metallic plates separated from each other by an insulating material of either



Discharge Through a High Resistance.

air, glass, ebonite or their equivalent. Without referring, at present, to the insulating material, let attention be called to the conditions which determine the amount of charge a condenser or Leyden jar is capable of receiving.



Oscillatory Discharge from a Condenser.

From a simple review of the situation it seems more than likely that the capacity of a body to receive a charge of electricity would depend upon certain geometrical as well as electrical conditions.

The question of importance, therefore, is one that brings them into prominence.

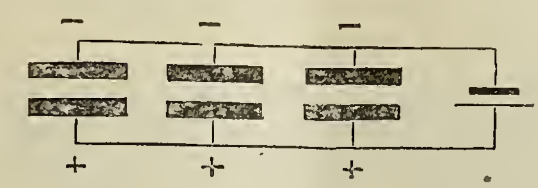
The larger a body is, the greater its area, the more competent it becomes to accumulate a great charge. And furthermore, not only, as previously remarked, will its nearness to another conducting body accentuate this property, but the fact that if the air were replaced by some other material it is more than likely that the effect would be further increased and the charge aggravated.

Thus from a glance so brief it is seen that the
Size,
Distance,
and Insulator
have a very noticeable effect upon the charge a body can accrete and hold.

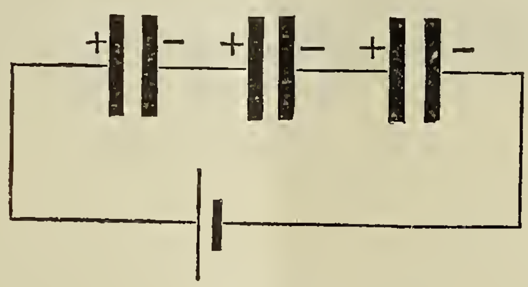
A comparison can very aptly be made between a condenser and a room.

The amount of air a room can hold depends upon its size and the pressure at which the air is driven in. The number of cubic inches of air are therefore solely determined by this. In speaking of the capacity of a room the number of cubic feet would designate this idea, but the geometrical conditions, the very dimensions are thus referred to. A condenser has no fixed capacity. It may be compared with another condenser by charging both with the same pressure, but otherwise the comparison fails.

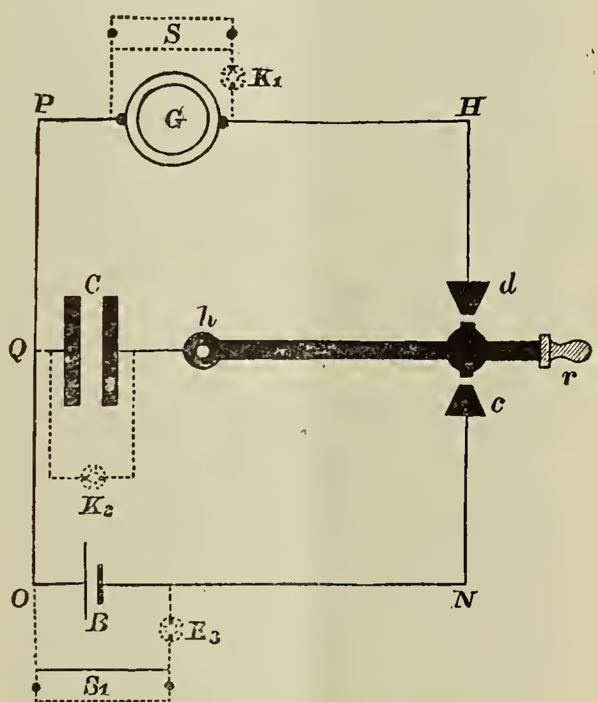
The meaning of capacity when a condenser is considered is spoken of in Farads.



—Condensers in Multiple Arc.



—Condensers in Series.



S and S1—Shunt Circuits.
C—Condenser.
hr—Lever of Discharge Key.
c—Lower Stop of Key.
d—Upper Stop of Key.
H, P, Q, O, N—Main Connections.
G—Ballistic Galvanometer.
K1, K2, K3—Simple Keys.
B—Battery of Standard Make (Clark's or Carhart's.

Unfortunately, a Farad is so large a unit that it could not be considered in a practical sense. The unit used in daily practice is the microfarad, the one-millionth part of a farad.

The quantity of electricity is spoken of in coulombs.

The number of coulombs or the amount of charge a body is capable of receiving, taking the past facts also into consideration, is dependent upon two factors—

The capacity of the condenser and the pressure. The amount of air in a room or closed tank would depend upon the size of either and the pressure applied; likewise a condenser.

The rule, therefore, illustrating these facts is as follows:

$$\text{Charge} = \text{Pressure} \times \text{Capacity},$$
$$Q = E \times F.$$

where Q = Coulombs,
E = Electromotive force,
F = Farads capacity.

It must be understood that the area of the plates, the distance between them, and *the nature of the material separating them*, will directly affect the capacity in all cases.

Definition of Capacity.—The capacity of a condenser is determined by the number of coulombs which will raise its pressure to one volt.

A Farad is the capacity of a body which is raised to one volt pressure by a charge of one coulomb.

Specific inductive capacity is an expression defining the extent to which an insulator will allow a charge to affect another body by induction.

It may be understood that air, glass, hard rubber, etc., retard the inductive effect of one body upon another to different extents.

Air is usually referred to as a standard, the induction occurring through it being very slight; the others are rated accordingly.

Specific Inductive Capacity.

Air	1
Rubber	2.3
Paraffine	2.3
Gutta-Percha	2.5
Mica	6.6
Glass	10.0

Glass and insulators made of materials likely to vary in quantity have a specific inductive capacity dependent upon their purity. The power of glass changes with the amount of lead, etc., it contains.

Condensers in Series.—When a set of condensers of equal capacity are connected in series the capacity of the group is reduced, but the pressure increased.

With capacities equal.—When the condensers are of equal capacity, the capacity of all connected in series is equal to the capacity of one divided by the number.

With capacities unequal.—When the condensers have different capacities and are connected in series, *the capacity of the whole is equal to the reciprocal of the sum of the reciprocals.*

Represented in symbols

$$K = \frac{1}{\frac{1}{K_1} + \frac{1}{K_2} + \frac{1}{K_3}} \text{ etc.,}$$

where K = total capacity
K_1 = capacity of first condenser
K_2 = " " second "
K_3 = " " third "

Condensers in Parallel.—When condensers are connected in parallel, *the entire capacity is equal to the sum of the capacities.*

Method of Direct Deflection.—The capacity of a condenser can be ascertained by reference to another condenser in a very simple manner.

In order that two charges may be compared, a galvanometer must be used whose deflection depends upon the amount of the charge sent through it.

A ballistic galvanometer serves this purpose to perfection. It does not differ in principle essentially from a reflecting galvanometer, except in regard to its swing.

It swings very slowly when subjected to a sudden discharge from a condenser.

Method.—If two condensers of unequal capacity are to be compared, one must be known.

Instead of a condenser, the other may be a section of submarine cable, etc.

Both are charged by a constant E. M. F.—a standard cell, for instance.

When the condenser of known capacity is charged, it is discharged through the galvanometer and the deflection noted.

The other conductor or condenser of unknown capacity is likewise connected and discharged through the galvanometer. The charges are compared by means of the deflections, and the capacities correspond likewise.

Supposing a condenser of one-half a microfarad is charged by a standard Clark cell, when discharged the deflection

$$d_1 = 80;$$

with the condenser to be measured the deflection

$$d_2 = 200.$$

The rule states as follows: Capacity of the first : capacity of the second = first deflection : second deflection.

In symbols

$$F_1 : F_2 = d_1 : d_2$$

F_1 = capacity of first condenser = ½ M. F.
F_2 = " to be determined.
d_1 = deflection due to ½ M. F.
d_2 = " " unknown capacity;

therefore,

$$F_2 = F_1 \times \frac{d_2}{d_1}$$

$$= \frac{1}{2} \times \frac{200}{80}$$

$$= 1.25 \text{ micro-farads.}$$

Condensers are generally made of alternate layers of tinfoil and mica, or tinfoil and paraffined paper.

A knot of cable about $1\frac{1}{6}$ miles equals ⅓ micro-farad capacity.

A condenser in many respects resembles a battery of very high internal resistance.

It has been discovered that condensers when exposed to a rapidly alternating electric current become heated. The paper if paraffined may dissolve the wax. This effect is due to *dielectric hysteresis.*

If the capacity of the great Atlantic cable could be reduced the passage of signals would be greatly accelerated. At present the cable must first be charged before a signal reaches the other end.

When alternating or interrupted currents are used a condenser prevents rapid communication; a coil of wire, if properly arranged in circuit, will in such a case neutralize its effect.

There being no practical limit to the capacity of a body, the greater the pressure the greater the charge it will hold. In telephone practice the wire is surrounded by crinkled paper, and the insulation over that, to surround it with air if possible—air having a specific inductive capacity equal to unity—thus reducing the induction and consequent charge.

Looking broadly at the value of alternating transmission as against continuous current transmission, we have a gain in the simplicity and safety in the transmission, and at the distributing end the use of multiphase currents enables us to supply both lamps and power with an economy and success comparable to that of the continuous-current system. If it is necessary to use continuous currents for certain types of distribution at the receiving end, they can be obtained by the use of rotary transformers, by which the alternating current is transformed into a continuous current. These machines have approximately the efficiency of corresponding continuous current dynamos, while the output for a given size is about 50 per cent. greater.

Amongst the contributions to Electrical Age by Mr. F. M. F. Cazin, the following may be mentioned as surely remembered by our readers:

Losses of Efficiency in Electric Transmission and Water-Power. July 6, 1895, etc.

A Simple Law, by Which the Diameter of Standpipes May be Adapted to the Natural Movement of Falling Water.

A Gauntlet Thrown to the British Board of Trade in Matters of Electrical Units.

Can an All-Solid Electric Incandescent Lamp be Made?

Solids, Falling in a Medium, I. and II. (Transactions of the American Institute of Mining Engineers).

SO-CALLED SOUL PHOTOGRAPHY.

The latter part of this article was translated for the "Literary Digest," through whose kindness we are able to reproduce the following extract complete with illustrations.

As a peculiar combination of science with seance, we think it indisputably the leader in its way:

France is the paradise of those who frequent the borderland between science and quackery. So closely do the two domains approach that it is often difficult to tell on which side of the line we are, and this is especially hard in the land of the Gauls, for the successors of the famous Cagliostro are very successful in aping the language and the methods of true scientific investigators, and reputable scientific societies and journals are much readier to give such men a hearing than are we in this country. Of late a school of investigators has arisen which claims to have reached remarkable results in the borderland between psychology and physics, although we shall hear nothing of it if we rely on the staid scientific journals of England, Germany, or the United States. But, as has been said, the French are more lenient, and hence we have in *Cosmos* (Paris, November 28) a long review by Dr. Albert Battandier, of the investigations of one Dr. Baraduc, on certain emanations from the human body that he has succeeded in photographing both with and without the aid of electricity. Dr. Baraduc thinks he has caught the human soul itself on his sensitive plates. Recently at Munich he exhibited no less than four hundred photographs of this kind. But his critic reminds us that no one else has ever succeeded in obtaining the same results, and that if we believe his statements we must also be ready to give up a large part of accepted physical laws. However, one or two of his alleged experiments may be interesting to our readers. Says Dr. Battandier:

Fig 1—Human and Electric Fluid Combined.
(By courtesy of Literary Digest.)

"First we have a curious experiment made in collaboration with M. Narkiewicz, which shows the combination of the human fluid with the electric fluid. An induction-coil is placed in the middle of an apartment. One of its poles is put to earth; the other terminates in a sort of condenser—a glass tube with copper stem surrounded with water. A spectator holds this condenser in his left hand and a Crookes tube in his right. The circuit being open, the Crookes tube is not illuminated, but, if another person approaches, it lights up, and, if he touches the globe with his finger, sheafs of light escape from his hand, penetrate the glass, and disappear in contact with the hand that holds the globe. This sheaf of light is milky, opalescent and whitish, with a golden-yellow centre; it has not the green tint of ordinary cathodic rays, and—here is the important point—it seems more brilliant when the person who approaches is strong and has great vitality. If this person withdraws, the globe ceases to glow. . . .

Fig. 2—Human Hair from a Fever Patient.
(By courtesy of Literary Digest.)

"This action is shown by the accompanying photograph (Fig. 1). . . .

"We have seen electricity combined with the human

fluid; here is a photograph where we have the human emanation alone. A person has a burning fever; a photographic plate wrapped in black cloth is placed on the epigastric region, the glass face against the skin. The exposure lasted an hour. In this abnormal state there is a superabundance of activity, projection without and expiration, as M. Baraduc calls it. What is expired? That is difficult to say."

Dr. Battandier goes on to say that we may have two theories of these photographs, assuming them to be *bona fide;* we may either go back to the old idea of some sort of material emanations from the organism, in which case we should have to explain in addition how such emanation could affect a sensitive plate; or we may believe in a "vital fluid" of some sort—a new kind of radiant energy, proceeding outward from the body and able, like light and electricity, to make an impression on a photographic plate. But probably it is too soon to offer an explanation at all. It would be doubtless more profitable to wait until Dr. Baraduc's results have been confirmed by some one else. It may be added that Dr. Baraduc claims also to have produced more wonderful results—photographs of familiar spirits and the like—which in themselves would, with most persons, discredit his whole work.

THE PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTRICAL ENERGY.

I HAVE spoken of the relative amounts of copper required by the single-phase, two-phase and three-phase alternating currents. I do not think it necessary to explain minutely the difference between these systems, as they are well understood. In a single-phase system a single alternating current is used. In a two-phase system two alternating currents, whose phases differ by 90°, are employed, while in the three-phase system there are three currents differing in phases by 60°. I shall consider the characteristics of these three systems, as there has been much discussion, especially as to the relative value of the last two of them for transmission work. I shall not discuss the various modifications of the systems, but shall confine myself to general considerations. There is no single-phase motor in successful commercial operation that does not require to be started from rest by some outside means. This prevents a single-phase current from being used at the present time for power distribution; and as, in most transmission, the distribution of power is an important item, single-phase currents are not suitable for this purpose. In a two-phase system the currents are usually carried on separate pairs of wires, while in the three-phase system three wires are generally used, a common return being unnecessary, as the sum of the currents is zero; unless the circuits are unbalanced. In distributing on the three-phase system a fourth wire can be employed, as it gives an advantage in the amount of copper used.

In all these alternating systems the great difficulty lies in the fact that the inductance of the circuit causes the current to lag behind the electromotive force. This decreases the amount of energy transmitted by a given current at a given voltage; it causes a drop in the voltage of the line, and it increases the armature reaction of the dynamo for a given current. The total inductance of the circuit is made up of the inductance of the transformers, of the dynamos, of the receiving apparatus and of the line. In the case of transmission to very long distances the line inductance is a large proportion of the total, while the inductance of the receiving apparatus depends upon whether lights or motors are to be supplied and upon the construction of the latter. When the different wires of the multiphase system are fed from windings on the same dynamo armature, then the drop in voltage due to any excess of load on one of these circuits cannot be compensated for on the dynamo itself. If the amount of current and the lag of the current is the same for all of the circuits of the system, then it is easy by a compounding-winding of the dynamo, or by changing the current in the field winding, if there is no compounding, to keep the voltage constant at either the sending or receiving end. When the load on the different wires of the system is not the same, however, it is, as I have stated, impossible to keep all of the circuits at the proper voltage. Where a two-phase transmission with separate circuits is used, then if the separate circuits are wound on different armatures, each can be regulated to give a constant voltage at the receiving end. This is the case, for instance, in the large dynamos built by the Westinghouse Company for use at the World's Fair in Chicago.

The difficulty due to the uneven loading of the circuits is specially marked in the case of the three-phase system, and it is one of the principal objections that have been urged against the employment of this system for distribution. It should be pointed out, too, that it is not enough to balance the quantities of current for the three branches of the system, but the character of the current must also be considered. A non-inductive load on one wire, with an inductive load of equal value on the others, would cause an unbalancing just as if the currents differed in amount. In most of the transmission plants that are being operated and that are proposed it is required to run both lamps and motors from the same circuits, and while a slight variation of potential on the motors would not cause any particular trouble, yet the successful operation of the lamps requires a practically constant voltage. I think, however, and the same grounds have been taken by others, that in any practical transmission of considerable size it is possible to so balance the loads that this difficulty will not exist to an extent to cause any serious trouble. When the distributing part of the lines is reached it is usually the custom when a three-phase transmission is used to employ four instead of three wires. As for line inductance in the two-phase and three-phase systems, there is no question that the latter has an advantage in this respect. By suitable arrangement of circuits the line inductance can be brought to a minimum, and this is of the utmost importance in long-distance transmission. I will not take into account the supposed increased efficiency of three-phase motors and dynamos as against two-phase apparatus, as there is a question as to whether a superiority exists; but simply considering the decreased amount of copper required and the decreased inductance of the line, there is no question, in my mind, that for transmission the three-phase system is superior to the two-phase. It is well known, of course, that the inductance of the circuit can be, in some measure, compensated for by the use of condensers or over-excited synchronous motors. The first of these remedies is, however, a very uncertain quantity commercially, while the second should be used as much as possible; that is, as many synchronous motors should be connected as is practicable. The best remedy, as things stand at present, lies in the careful construction of the line and the apparatus, so that the effects, although they exist, can be reduced to a minimum.

It has been shown by Mr. Scott, and others, that it is possible to transform a two-phase into a three-phase current, to transmit it and to transform it back again to a two-phase current. This will allow us, if we wish, to use two-phase dynamos for generating the current, to transmit with the advantage incidental to the use of three-phases, and at our reducing end to use two-phase circuits for transmission. This has some advantages as far as balancing the voltage on the circuits goes, and it has been proposed in the case of several plants whose installation is being considered.

(To be Continued.)

Great Storage Battery.—The Hartford Electric Light Company has lately set up and is now using the largest storage battery ever made. It consists of 130 cells, and it holds so much electricity that if the supply should be entirely shut off this battery would keep twenty-four thousand lights burning for an hour.

As is well known, the Hartford Electric Light Company receives a large amount of its power from the water-wheels at its great dam on the Farmington River near Poquonock. Part of the time the demand upon the works is greater than can be met by the water-power alone; at other times the water goes to waste, for the stream of the river is continuous, while the call for light is most of it condensed in a comparatively brief part of the day. It begins, say, about 4:30 o'clock and continues until 10 or 11 o'clock.

By means of this storage battery a great economy is effected. As soon as the demand for light slackens, the power is turned into this battery and the water, instead of going to waste over the dam, is used for manufacturing electricity to be accumulated for use when needed. As a result of this change the fires will soon be practically extinguished altogether at the State street station, and no steam, except for heating purposes, will be generated by the company except at its leased Pearl street plant, where the boilers will do duty as auxiliary to the Farmington River and the storage battery.—Hartford Courant.

POSSIBLE CONTRACTS.

Columbus, Ga.—The water-power development of the Brush Electric Light & Power Co. will be enlarged to about 2,000-H. P. from 1,200-H. P., thereby enabling it to furnish electric power to small industries. Address John F. Flournoy, president.

Sistersville, W. Va.—Endeavors are being made to organize a company for the purpose of constructing an electric light plant. Address Cashier, Tyler County Bank, for further particulars.

Proposals for the construction of an electric light plant for a town of 1,600 inhabitants will be opened January 20. Plans can be seen at the office of the city clerk, Rockville, Md., or at the office of John C. Morgan, 1012 New York Life building, Chicago, Ill.

Webster Groves, Mo.—The residents of Webster Groves propose to establish an electric light plant. The estimated cost of the plant is $20,000, and it is proposed to issue bonds and secure the money.

Cumberland, Md.—An ordinance has been passed by the city council for an election to be held for the purpose of securing a $20,000 electric light plant. Address the mayor for further information.

Hagerstown, Md.—The Hagerstown Electric Co. will enlarge its plant. It intends building a new power house of 700 horse-power, to be supplied to commercial and private houses.

Raleigh, N. C.—The electric lighting plant of the Raleigh Street Railway Co., which was recently destroyed by fire, will be rebuilt by the company.

Albany, N. Y.—An immense electric plant will be erected on Pleasure Island by the Paul Boynton Co., and over 200 electric lights will be distributed throughout the place.

Bancroft, Ont.—Bancroft is trying to secure electric lighting.

NEW CORPORATIONS.

N. Y. City.—The Westchester Gas & Electric Co., which has succeeded the Consolidated Gas & Electric Co., has been incorporated with a capital stock of $300,000. The incorporators are James M. Pemberton and Albert L. Chester, Westerly, R. I.; George V. Foster, N.Y. City; Wallace Hackett, Portsmouth, N. H.; Herbert T. Jennings, Mount Vernon; Paul Armitage, Bay Shore, and Henry D. Donnelly, Brooklyn. The company will supply gas and electricity for heat, light and power in the villages of New Rochelle, Larchmont, Mamaroneck, Harrison, Rye and Port Chester.

Brooklyn, N. Y.—The Ward & Upright Engineering Co. has been incorporated to carry on a general machine manufacturing business. Capital, $7,000. Directors, George W. Ward, Chas. W. Upright and James B. Upright.

N. Y. City.—The Vice-Versa Electric Lamp Co. has been incorporated with a capital stock of $5,000, by Joseph Worth, Maurice L. Hayman, and George W. Gorton.

Renfrew, Ont.—The Renfrew Electric Light and Power Co., ltd., is applying for an Ontario charter. Place of business, Renfrew. Capital, $90,000. The applicants are W. H. Mackay, A. A. Wright, W. T. Guest, A. C. Mackay, H. Wright, Renfrew.

NEW TELEPHONE COMPANIES.

Savannah, Ga.—The Savannah Telephone Co. has been incorporated by J. A. G. Carson and others, with a capital stock of $25,000; to construct and operate telephone systems, etc.

Marlington, W. Va.—The Pocahontas Telephone Co. is being incorporated by W. A. Bratton. The company will construct a telephone system from Rouceverte to Marlington by way of Lewisburg. The line will cost about $1,500.

TELEPHONE NOTES.

Nebo, N. C.—The Cumberland Telephone Co. is considering the extension of its lines to Dalton, Richland and Silent Run.

Angleton, Tex.—A fifteen and one-half-mile line is being constructed from Angleton to Velasco, by the Angleton Telephone Co. The company also intends constructing a line to Alvin, a distance of twenty-three miles. G. C. Garrett, contractor.

REORGANIZED.

President Charles Schimmelfing and Vice-President and General Manager Alfred Short, of the newly organized Eureka Tempered Copper Company, of North East, Pa., were in town January 6 and 7, attending to some important interests they have here. The new company has a paid-up capital of $100,000. In conjunction with their New York enterprise they will carry on a more extensive electrical business than ever before.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued November 10, 1896.

570,906. Electric Burglar Alarm. C. Coleman, Chicago, Ill. Filed Dec. 21, 1895.

570,911. Electrical Self-Playing Piano. G. H. Davis, New York, N. Y. Filed Sept. 14, 1895.

570,914. Dynamo-Electric Machine. G. E. Dorman, Chicago, Ill. Filed Feb. 4, 1896.

570,945. Electric Locomotive. J. F. McLaughlin, Philadelphia, Pa. Filed June 24, 1891.

570,955. Automatic Safety Circuit Closer. W. L. Pratt and F. E. Ripley, New York, N. Y. Filed Jan. 20, 1896.

570,967. Electric Annunciator. J. Stamm, Stuttgart, Germany. Filed July 10, 1895.

571,032. Electric Meter. C. Wirt, G. R. Green and H. Burger, Philadelphia, Pa. Filed March 7, 1896.

571,036. Electric Meter. H. Burger and W. H. McFall, Philadelphia, Pa. Filed March 7, 1896.

571,037. Electric Meter. H. Burger and W. M. McFall, Philadelphia, Pa. Filed March 7, 1896.

571,043. Electric Motor. G. R. Green, Philadelphia, Pa. Filed March 7, 1896.

571,050. Detent for Ratchet Wheels. W. D. Marks, Philadelphia, Pa. Filed Aug. 22, 1896.

571,059. Electric Storage Battery. T. W. Allen, London, England. Filed Feb. 18, 1896.

571,092. Trolley for Electric Railways. P. C. MacEvoy, Brooklyn, N. Y. Filed Dec. 10, 1895.

571,093. Multiple Fuse-Block. E. H. Montgomery, St. Paul, Minn. Filed Aug. 10, 1895.

571,097. Automatic Circuit-Breaker. W. H. Powell, Hartford, Conn. Filed June 15, 1896.

571,099. Electrical Discharge Device. C. E. Skinner, Pittsburgh, Pa. Filed May 21, 1896.

571,103. Lightning Arrester. A. J. Wurts, Pittsburgh, Pa. Filed March 11, 1896.

571,107. Electrically Controlled Derails for Railway Crossings. J. P. Coleman, Edgewood Park, Pa. Filed June 1, 1896.

571,109. Lightning Arrester. J. P. Culgan, Swissvale, Pa. Filed June 1, 1896.

571,119. Electric Switch. W. W. Hibbard, Rochester, N. Y. Filed Nov. 21, 1893.

571,120. Electric Railway Trolley. H. D. Hinckley, Hartford, Conn. Filed Aug. 12, 1895.

571,137. Electric Arc Lamp. H. R. Palmer, Norfolk, Va. Filed March 25, 1896.

571,143. Electrode for Secondary Batteries. H. Woodward, Toronto, Can. Filed March 22, 1896.

571,162. Telephone Switch. E. M. Harrison, Chicago, Ill. Filed Nov. 21, 1894.

571,181. Field Magnet Pole. J. J. Wood, Fort Wayne, Ind. Filed Sept. 8, 1896.

571,190. Magneto Telephone. E. M. and W. S. Harrison, Chicago, Ill. Filed Nov. 21, 1894.

571,248. Electric Light Attachment. J. H. Rusby, Nutley, N. J. Filed April 30, 1896.

571,257. Electric Heating Apparatus. A. E. Appleyard, Natick, Mass. Filed Jan. 30, 1896.

571,270. System of Electrical Distribution. J. F. Kelly and C. C. Chesney, Pittsfield, Mass. Filed July 30, 1896.

571,288. Electric Gas Lighting Device. E. Schmidt, Berlin, Germany. Filed Aug. 1, 1896.

571,297. Electric Wall Box. W. F. Bossert, Utica, N. Y. Filed Aug. 3, 1896.

571,300. System of Electrical Distribution. C. C. Chesney and J. F. Kelley, Pittsfield, Mass. Filed Dec. 3, 1895.

571,301. Station Indicator. D. E. Conner, Covington, Ky. Filed June 29, 1896.

571,305. Magneto Generator. J. C. Francis, New York, N. Y. Filed Jan. 2, 1896.

571,310. Dynamo-Electric Machine. R. Lundell, Brooklyn, N. Y. Filed Oct. 7, 1895.

ELECTRIC STOCK QUOTATIONS.

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	35	38
Edison Illg. Co (St. Louis),	10	17
Eddy Electric Mfg. Company,	—	19
*Edison Elec. Illg. Co., New York,	102½	103½
Edison Elec. Illg. Co., Brooklyn,	98	100
Edison Ore Milling Co.,	7	10
Edison Elec. Storage Company,	28	29
East End Electric Light Co.,	—	—
Fort Wayne Electric Company,	3	3½
Ft. Wayne Elec. Co. T. Sec. Series A,	3	4
General Electric Company,	33¾	34¼
General Electric Company pf.,	75	77
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	81½	82
Rhode Island Elec. Protec. Co.,	110	122
Toronto (Canada) Elec. Light Co.,	126	133
T.-H. Elec. Co., T. Secur., Series D,	3½	4¼
Thomson-Houston Welding Co.,	5	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse El. & Mfg. Co., pf.,	50½	52
Westinghouse El. & Mfg. Co., assd.,	23	24

*Ex dividend.

The Electrical Age.

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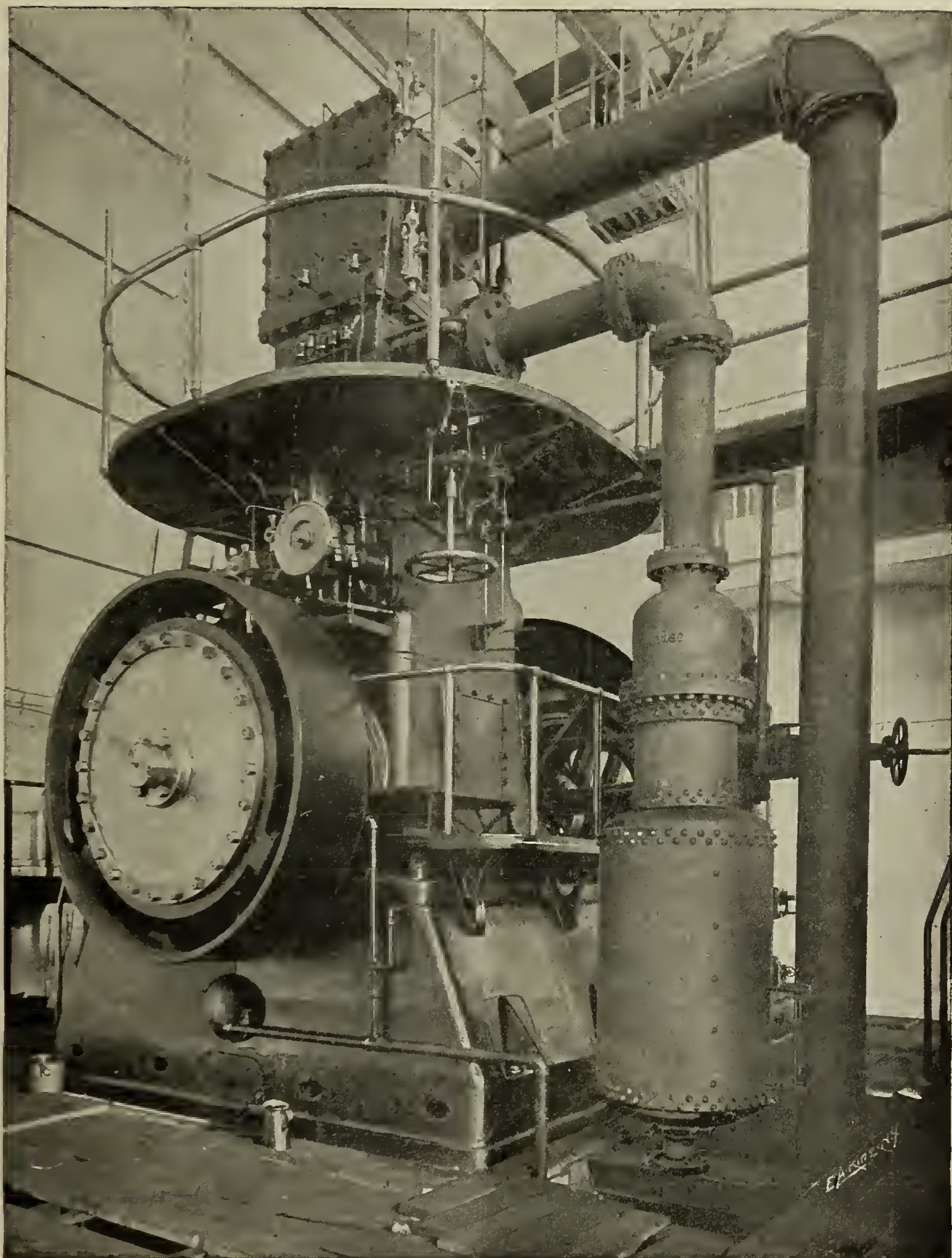


10-inch Stratton Combined Separator and Steam Receiver connected to 1,200 H. P. Compound Westinghouse Engines at the Power House of the United Electric Light and Power Company, 28th Street, New York City.

AUXILIARY APPLIANCES IN CONNECTION WITH A MODERN STEAM PLANT.

It has been stated by a distinguished French writer that the fault of the present epoch is due to the fact that we aim at perfection in the lesser things of life. It is but a matter of a moment's reflection to realize that mere aggregates compose the greater things, and that the perfection of the smaller invites the finished completion of the whole. In the field of steam engineering there is nothing that appeals more strongly to the observant eye than the elaborateness of the modern steam plant. It seems that a prevailing sentiment has left its impress upon the entire mechanism and written in unmistakable language the word "economy" on every part.

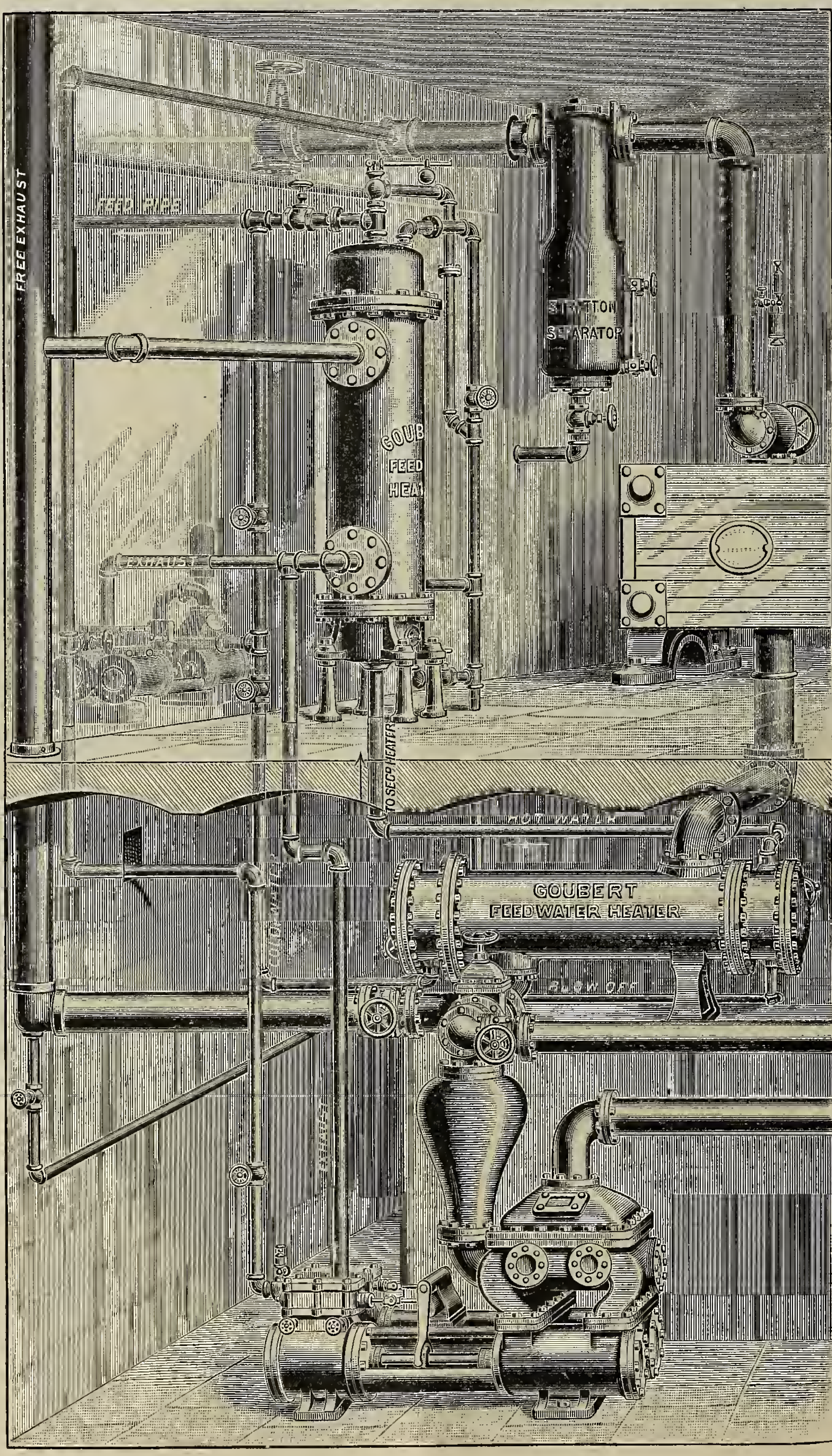
Modern steam plants are therefore composed of two essential elements, the boiler and engine, and a series of accessories whose function it is to add convenience and prevent waste of heat, of steam and, consequently, of power.

A feed-water heater is a device that stands prominently forth as a factor of this nature. It absorbs heat that in the recent past had always been wasted. The steam that leaves the engine after having expanded and given up the power we have availed ourselves of still retains considerable heat, which may be used for increasing the temperature of the water the boiler is being fed with. The steam gives up its latent or hidden heat to the fresh water, thus saving considerable fuel that would otherwise be required for equivalent thermal conditions. This exhaust steam may be either brought in contact with the feed-water or merely in proximity with it. It is dangerous to the life of the boiler to follow the practice of using heaters in

which the exhaust steam and feed-water meet. But there is no objection to having the exhaust steam enter a cavity or shell within which is a similar apparatus through which the feed-water passes and is thereby heated. Within either the one or the other the steam enters, and it is well to state that those feed-water heaters, composed of a large shell to hold the steam and a set of tubes within to carry the water, are of the most durable and economic design.

The Goubert feed-water heater contains the essence of these principles. Exhaust steam enters an enclosed shell containing a set of tubes; it strikes their outer walls, delivering its heat to the water within and then condensing. The shell is of sufficient area to remove all danger of back pressure and is likewise provided with a drip for the condensed steam; neither grease nor sediment collects either in the outer shell or inner tubes. The drip carries off with it all oil or grease that may have accidentally entered with the steam; and a deflector prevents the insoluble mineral matter of the feed-water from rising upward through the tube, but allows it to collect at the bottom, which in the vertical type represents a cup-shaped cavity.

The illustration shows the application of a Goubert feed-water heater to a modern condensing engine. A heater of the horizontal type is introduced in the path of the steam between the engine and the condenser. The feed-water is forced by the feed-pump through this apparatus, and therein becomes heated to a temperature very near that of the steam. Under such conditions as may be due to the vacuum carried, this temperature ordinarily averages somewhere near 120°, with a vacuum of, say, 26″. The feed-water leaving this first apparatus is then forced through, on its way to the boiler, another heater, called a supplementary. Into the shell of this heater is exhausted the steam from the various auxiliaries, such as the air-pump, the feed-pump, jacket-pumps, etc. This exhaust being under atmospheric pressure, and consequently at a temperature of 212°, the feed-water that has already been primed in the first heater to 120° can be heated in the second to very nearly 200°, that is to say, to as high a temperature as would be the case if the engine were non-condensing.



Arrangement of Primary and Supplementary Heaters in Connection with Condensing Engine.

An additional appliance that has added greatly to the period of usefulness of engines is the "separator." This

device separates the water or moisture from steam about to enter an engine, thus removing entirely the danger arising from water in the cylinder head. Dry steam is so essential in the successful operation of a steam plant that moist steam is like the introduction of deadly disease germs into the human blood; a general disorganization ensues and the mechanism becomes entirely disabled. An extract from a report on this subject by J. E. Denton, Professor of Experimental Mechanics in the Stevens Institute, regarding the Stratton separator, reads as follows:

EFFICIENCY OF STRATTON SEPARATOR.

An average of five experiments aggregating one hundred and fifty minutes.

Pounds of dry steam per hour	608
Percentage of moisture entering separator . .	.27
Percentage of moisture leaving separator . .	0
Proportion of moisture eliminated by separator .	100

As the basis of economical operation there is not the slightest doubt but that it rests upon the use of a properly designed separator. The illustration shows a Stratton Combined separator and steam receiver used in the U. S. Light and Power Co., 28th street, N. Y. City. It combines within itself the features of a separator and steam receiver. It not only insures a supply of dry steam but furthermore passes it over at the full working pressure. It occupies but little space and looks neat and compact. The Goubert Manufacturing Company, 14–16 Church street, N. Y., have manufactured and introduced this separator with the greatest success in all the best known steam plants of the United States.

St. Louis, Mo.—Bids will be opened April 9 for lighting the streets and public places of the city by electricity. Address Robert E. McMath, president board of public improvements, for full particulars.

THE RENO INCLINED ELEVATOR.

What may prove in the course of time to be one of the most popular devices used in office buildings or apartment houses is now being tried at the New York end of Brooklyn Bridge.

In principle it is that of the endless belt driven by a source of power, the people trying it merely standing on the belt and being carried with it to the head of the stairs. Mr. Jesse W. Reno is the inventor of this remarkable machine. Its novelty has attracted crowds in the past, it being estimated that at least 75,000 people enjoyed the pleasure of a ride on it at Coney Island last year.

The endless belt spoken of carries on its surface a set of cast iron strips attached at right angles to the length of the belt. The metal strips are so linked together that they form a substantial but flexible foothold. Sprocket

BY COURTESY OF THE SCIENTIFIC AMERICAN Reno Inclined Elevator at the Brooklyn Bridge.

wheels carry the entire chain-like belt with a uniformly continuous motion. Small rollers or wheels carry the cast iron strips over the inclined support. This support is rigid and consists of two I beams parallel to each other and flanged. The rollers rest upon these flanges and make the upward movement of the slats pleasant and even.

The transfer of a passenger from the floor to the moving machine and then to the upper platform is unique and ingenious.

The cast iron cross-pieces are ribbed and these hand-like ribs are met at the base and top of the staircase by an iron platform, which by means of comb-like projections fits snugly into the grooves below while preserving the continuity of the floor, and meets the same above, belonging to the platform upon which the passenger is almost unconsciously deposited.

The upward rise below prevents any possible danger of clothing, etc., catching, while above the parallel ribs fit

so snugly into the interstices of the upper platform that the transfer is made of the foot upon the stationary metal plate almost imperceptibly. The hand rail likewise moves on the same principle, being composed of an endless sprocket chain covered with leather and rubber. This rail and the platform move at a uniform and equal speed.

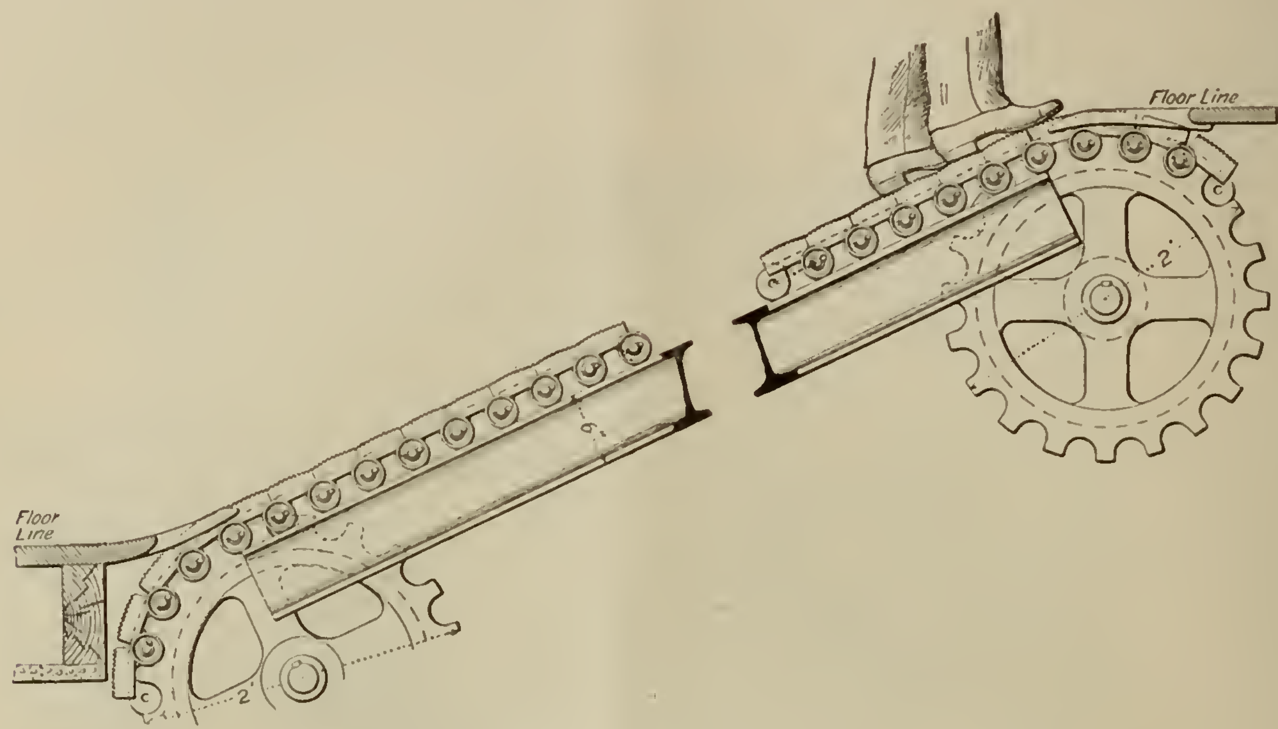


Fig. 2.—Showing Method of Transferring Passenger.

In the illustration the motor driving the device is under perfect control, as it may be controlled from either end of the staircase by means of a button. It is bolted directly to the main framework of the machine, as shown in cut. The capacity of an elevator is over 2,500 per hour of the 2½-feet width. The double file elevator is four feet wide and has a capacity of 5,000 passengers an hour.

If used in combination with a narrow staircase, the Reno elevator can be used for ascending and the stairs for descent.

The safety and convenience of this arrangement is so obvious that we believe either this or some equivalent device will be used for the purpose that its use implies.

The inventor believes the value of the second floor in buildings will be greatly increased by its introduction and a considerable appreciation in the value of the property will follow.

THE CITY OF DALLAS.

The following resolutions were passed at our council meeting last Tuesday, January 1, 1897:

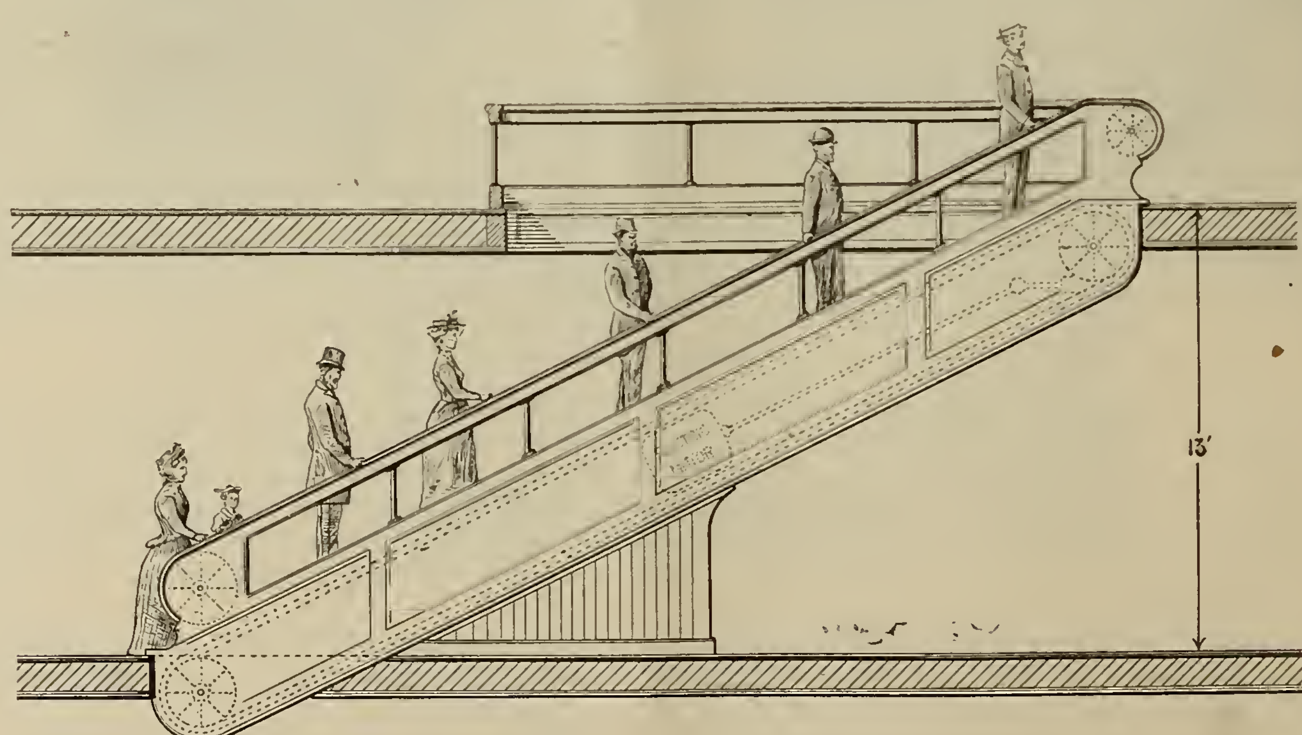
Whereas, the contract for lighting the city now held by the Dallas Electric Company expires November 3, this year;

And, whereas, considerable time is necessary to investigate matters connected with same looking to the betterment and cheapening of said lighting system; therefore,

Be it resolved that the light committee, in connection with the city electrician, investigate and report to this council at as early a date as possible what, in their opinion, would be the most economical and satisfactory course to pursue, and what system of lighting would be the most satisfactory and cheapest for the city to use.

Be it further resolved that said committee and electrician investigate the surplus boiler capacity now at Turtle Creek pump house, and bring in an estimate on the necessary machinery and construction material for 300 arc lights.

W. A. Fraser,
City Electrician.



The Reno Inclined Elevator.

THE PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTRICAL ENERGY.

DR. LOUIS DUNCAN.

POSSIBLE VOLTAGES AND DISTANCES OF TRANSMISSION.

A NUMBER of calculations have been made as to the possibility of transmitting electrical energy to very long distances. If the question of cost of transmission alone is considered, then where water powers or culm heaps are within distances of 100 miles of some large centre of consumption, it has been shown that it would be profitable to generate and transmit electrical energy. In these calculations, however, voltages are assumed that have never been employed for commercial plants, and whose availability is problematic, while sufficient stress is not apparently laid on the question of the reliability of the power. If the industries of a large city depended upon a single transmission plant, it is evident that the question of reliability is of paramount importance. Where energy is supplied to manufacturers, to street car systems and for lighting, a break-down that would involve the cutting off of current for a day would mean an enormous pecuniary loss to the community. As the distance of transmission increases, the possibility of accident is increased in greater ratio because we have not only the higher voltages to control, but the length of the line that must be looked out for is also increased. The best guide lies in the practical experience which has been obtained in the present transmission plants and the consideration of the difficulties that have arisen and the remedies that have been employed. I have prepared a partial list of the principal transmission plants that are now in operation.*

It will be seen that the longest transmission is at Fresno, Cal., the distance being about 35 miles. The highest alternating voltage used is 13,000 volts at Zurich, Switzerland. The highest direct potential is 15,000 volts at Brescia.

All of these plants are working successfully, and this fact will lead to still longer transmission and higher voltages. No limit of either distance or potential has as yet been reached. If we consider the record of the present transmission plants, we can safely say that it would not be going outside of the safe limit of development to transmit at least 50 miles at a potential of 20,000 volts, provided the energy could be delivered at such a price as to be considerably lower than the cost of a corresponding amount of energy obtained from a steam plant. This, of course, is a matter of local condition entirely, and the commercial value of such a transmission will depend upon local conditions.

LONG DISTANCE TRANSMISSION FOR RAILROAD WORK.

The possibility of long distance electric railroad lines is intimately connected with the possibility of long distance transmission of power. We have seen that it is possible to transmit considerable distances from a single station. The current so distributed is not, however, such that it can be applied directly to railroad motors, but it must be transformed at points along the line, the distance apart of these points of distribution depending upon the system that is employed. At present continuous current motors are used, and considerations of safety would lead us to use line potentials not greater than 700 volts. By distributing rotary transformers at distances of five or six miles apart, we would be able to supply motors with current without any great investment in copper. The amount of copper required could be still further reduced by using rotary transformers with storage batteries, thus keeping a constant load on the transmission line. It will be found, however, that on any long distance railroad line, the load on any section of the line is exceedingly variable and the discharge rate of the batteries will have to be very high in order to prevent excessive cost for our reducing stations. It is doubtful whether we have reached a point in battery construction that this system of transmission would be economical. It is certain, however, that when the distances are comparatively short, say within 15 miles, and where the traffic is not evenly distributed, that rotary transformers, with or without batteries, can be economically employed for railroad work.

CONCLUSIONS.

My conclusions, subject always to the influence of local conditions, are as follows:

1. In both direct-current lighting and traction systems, where the power is generated in or near the area of distribution, it is best to use one station situated at the most economical point for producing power.
2. In the case of the traction systems, where the economical area of direct distribution is passed, boosters should be employed directly or in connection with batteries, to a distance of ten or twelve miles from a station, and beyond this rotary transformers, whether with or without batteries should be used.
3. In the case of direct current lighting systems, the energy should be transmitted to storage batteries situated at centres of consumption either directly or by means of a rotary transformer and distributed from them.
4. Where batteries are used it is best to place them at the end of feeder wires to obtain the advantage of a constant load on the wire.
5. The best system for the long distance transmission of energy, for general purposes, is the three-phase alternating system.
6. Commercial transmissions are in successful operation for distances of 35 miles, and for voltages as high as 15,000 volts.

Experience with these plants shows that the transmission of 50 miles with a pressure of 20,000 volts is practicable; beyond these limits the transmission would be more or less experimental.

*The table referred to is found on the editorial page of January 16th issue.

Telegraphing Without Wires.—On December 12, at Toynbee Hall, Mr. W. H. Preece delivered an address to a crowded audience on "Telegraphing Without Wires." Mr. Preece said that in 1884 he was astonished to learn that the operators in the offices of the Exchange Telegraph Company in Gray's Inn Road were able to read by ear the messages that were going along the wires overhead from London to Bradford. He set himself to think about the matter, and eventually found that it was due to the electrical waves in the air. After this the matter was carried further, and experiments, which were made in the North of England, showed that it was possible to bring a system of telegraphy without wires into practical and excellent effect. The system was a very simple one, and consisted practically in conveying electrical magnetic waves across space. The waves, and thus the messages, could be conveyed between England and France, and all that was wanted was a coil of wire on each side of the Channel of the same length as the Channel's breadth. The current thus generated on the one side would be observed on the other. The system was of practical value, too, in that the messages, although received at one point, could be distributed to any number of other points. An attempt to establish means of communication by this system between the shore and lightships had been tried, and £1,000 had been spent on the experiment. Up to the present the experiment had not turned out a success, but he did not despair of being successful.—London Invention.

OSBORN ELECTROMAGNETIC RAILWAY.

The Osborn system of electric traction, illustrated in our pages, is practically a type of the so-called block system that on various occasions has been tried with varying degrees of success. One of the first to bring a system of this kind to the writer's notice was Mr. Wilcox, of Newark. In the cellar of his home or factory he had in working operation a four or five-horse power railway truck, running on a circular track provided at intervals with electromagnetic devices working automatically and supplying current to the car when required.

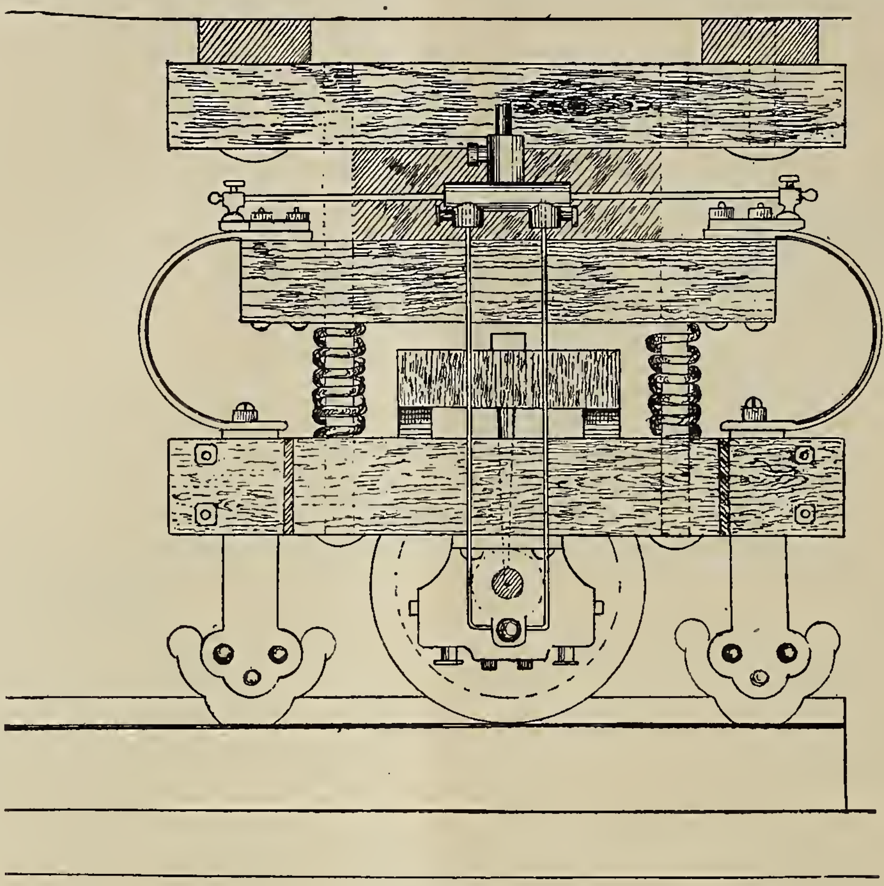


Fig. 2.

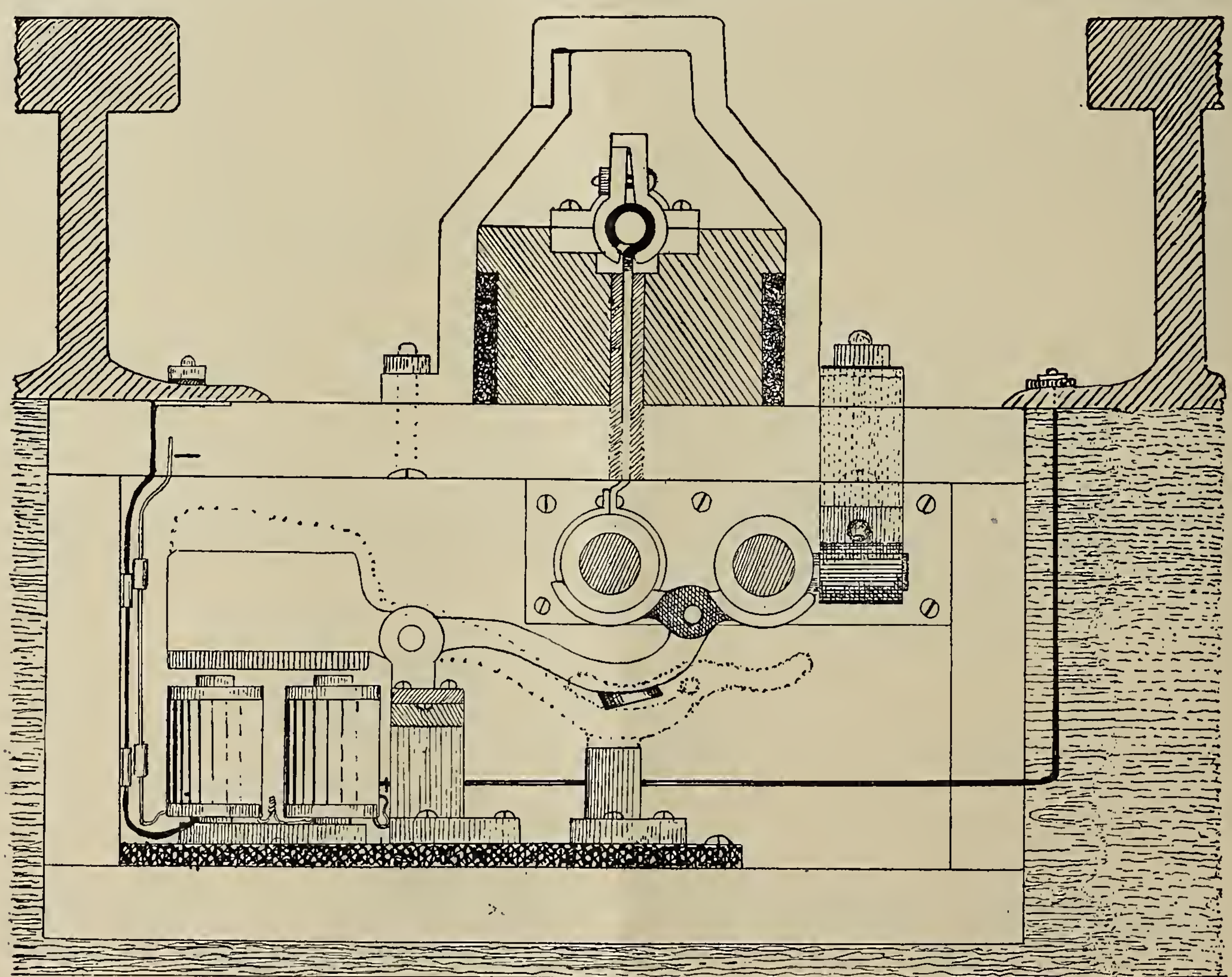


Fig. 1.

The difficulty of overcoming certain objectionable features that have always been stumbling-blocks in the way of the inventor or improver practically prevented any headway being made in this particular phase of electric railroading.

One of its most inviting characteristics is the absence of an overhead trolley and the practical continuity of the roadbed. During the recent agitation of the last few years against trolley roads a great many inventors turned their attention to the solution of so important a problem - the design of a system devoid of the unsightly trolley, yet whose source of supply was just as convenient for instant use.

In Mr. Osborn's system the roadbed has the usual surface rails, and situated midway between them is a third rail, shaped like an inverted V, in the interior of which, insulated and sealed from air and water, is secured the wire leading from the positive pole of the dynamo. The two surface or car-wheel rails and the central rail are each furnished with a trolley and friction shoes, which are held in a yielding frame, and this is attached to the frame of the truck. Each car carries a small storage battery or a few couples of galvanic cells beneath a seat, and this

(Continued on Page 56.)

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CONTENTS.

THE INSTITUTION OF PUBLIC LABORATORIES.

In England Mr. Ludwig Mond, F.R.S., has expressed a practical feeling of generosity that is unique in its character. He has founded and endowed a laboratory which is at the disposal of every worthy scientific investigator. The laboratory is situated at No. 20 Albemarle street, London, equipped with the latest scientific apparatus. It will prove a perfect elysium to those whose lives are devoted to their work.

There are at least sixteen separate laboratories for research work, many additional rooms for special experiments and a museum richly endowed with a variety of scientific appliances. The building in which these laboratories have been installed was at one time the residence of Lord Cowley. A wine cellar, in which this gentleman took a certain amount of national pride, has been transformed into a vault preserving within its confines a constant temperature. Many eminent men attended the opening of this institution. Dr. Mond, on Tuesday, December 22, 1896, formally transferred this $500,000 gift to the care of its distinguished directors, Lord Raleigh and Prof. Dewar, who, with the aid of Dr. Alexander Scott, the superintendent, will undertake its management. The Prince of Wales in addressing Prof. Mond said: "It affords me much satisfaction to assist at the opening of the series of beautifully arranged and well equipped research laboratories which this country owes to your generosity, and I congratulate the members of the Royal Institution of Great Britain on this most important accession to the resources which have been placed at the command of the institution for the advancement of chemical and physical science." Neither Lord Raleigh nor Prof. Dewar receive any remuneration for the work they have undertaken.

TELEGRAPHING WITHOUT WIRES.

There is no statement received with greater incredulity by the semi-wise public than that which refers to a method of telegraphing without wires. The reason why so much doubt is expressed is due to the fact that the field of science embraced by experiments in this direction is beyond the ken of the ordinary layman, and sufficiently advanced to cause the superficially educated individual to smile in a suggestively knowing way upon results obtained in it.

It is fortunate for us that in the economy of nature there is sufficient groundwork for us to build upon in our attempt to establish a practical system of wireless telegraphy. The phenomenon of induction which exhibits itself either with a static charge or a current is the basis upon which all our hopes depend for a telegraphic system dispensing with wires between the points of communication. Let it be clearly understood that telegraphy without wires in this sense loses none of its usefulness because it would be impossible for even the greatest storm to interfere with a system of this description.

Mr. Preece, of England, has been so impressed with the advisability of further and immediate investigation of the subject that he secured an appropriation for that purpose. His object was to find the means by which signals can be transmitted and the conditions affecting their clearness and continuity. It seems that the limitations of each particular experiment attempted depends upon the distance and nature of the current. The instant a current is started in a wire it becomes the focus of a series of magnetic whirls extending along the length of the wire. These magnetic "maelstroms" radiate outward into space, and when they strike another conductor create in it an electrical disturbance strong or weak depending upon their intensity and the distance traversed. To demonstrate the usefulness of this principle a long wire is stretched upon poles and a mile or so away another wire is suspended parallel to the first. If the current in the first wire is interrupted or varied, the second wire will become similarly affected and give issue to a series of electric impulses corresponding to the first. If appropriate apparatus is employed, signals may be thus exchanged between points widely separated and having no metallic connection with each other of any description. In times of war the usefulness of this device can hardly be questioned. At sea, vessels that have not appeared within each other's horizon could by this means correspond freely. There is no doubt but that a rapid development will follow the first successful series of experiments conducted on this principle. We believe that a problem of this kind is as important as that of producing cold light, and it seems that the time is almost ripe for us to receive the practical benefits of such work.

Transforming Wood into Gas.—A useful discovery is announced in L'Echo Foreiestr by F. Riche, an engineer. It is known that motive power, instead of being produced by steam, can be had directly from the coal transformed into gas. The defects of this gas, however, are its small per cent. of richness, its cost, and the scarceness of the coal, from which, in certain localities, it can be extracted, though even with these disadvantages the motive power thus produced is cheaper than that obtained by ordinary means. Means have now been found by M. Riche for transforming the whole of wood into gas, the latter having, he says, a power four times greater than that yielded by bituminous coal, which can be applied to the production of numerous ceramic products, such as glass manufacture, Bessemer hearths, and like industries. Owing also to its richness in carbonic oxide, it can be made use of in the manufacture of various chemicals, such as oxalic acid, and this at a much lower cost than at present.—Industrial World.

generator makes its circuit through the surface rails, passing through certain electromagnets sealed in a chamber or box, where a metal yoke attracted by the electromagnets is forced into contact with the stationary contact pieces, one of which is in contact with the dynamic wire and the other with the V-shaped rail. The current passes through this yoke to the said rail, and is thence transmitted to the controllers, and by motorman switched on to the motors of the car. The central rail is sectional and embedded in insulating material. After the car has gone over one section of the central rail, which may be of any desired length, but in cities preferably less than the length of a car, the circuit in that section is broken, and instantly the exposed central rail becomes electrically dead. In this way no danger can be feared from live wires or track, as the whole electrical current is confined to the space underneath the car. The system is adapted to any street railway or to any railroad.

The great point of having a track that is rendered automatically alive or dead, active or inactive at the instant of use makes it an unusually attractive problem to work upon.

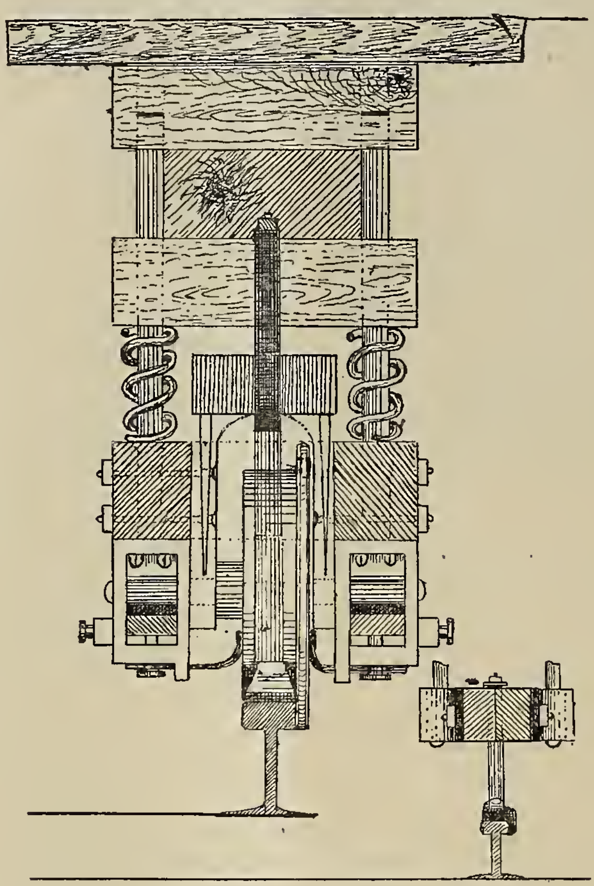


Fig. 3.

The description of the cuts is taken direct from the company's circular and reads as follows:

Figure 1 is a transverse section of the roadbed showing the third rail used in the complete system. Within this convexo-concave rail is seen the positive wire from dynamo. This rail may be entire or composed of two sections, as shown. The manner of attachment of metallic ribbons or conductors together with the connecting pieces,

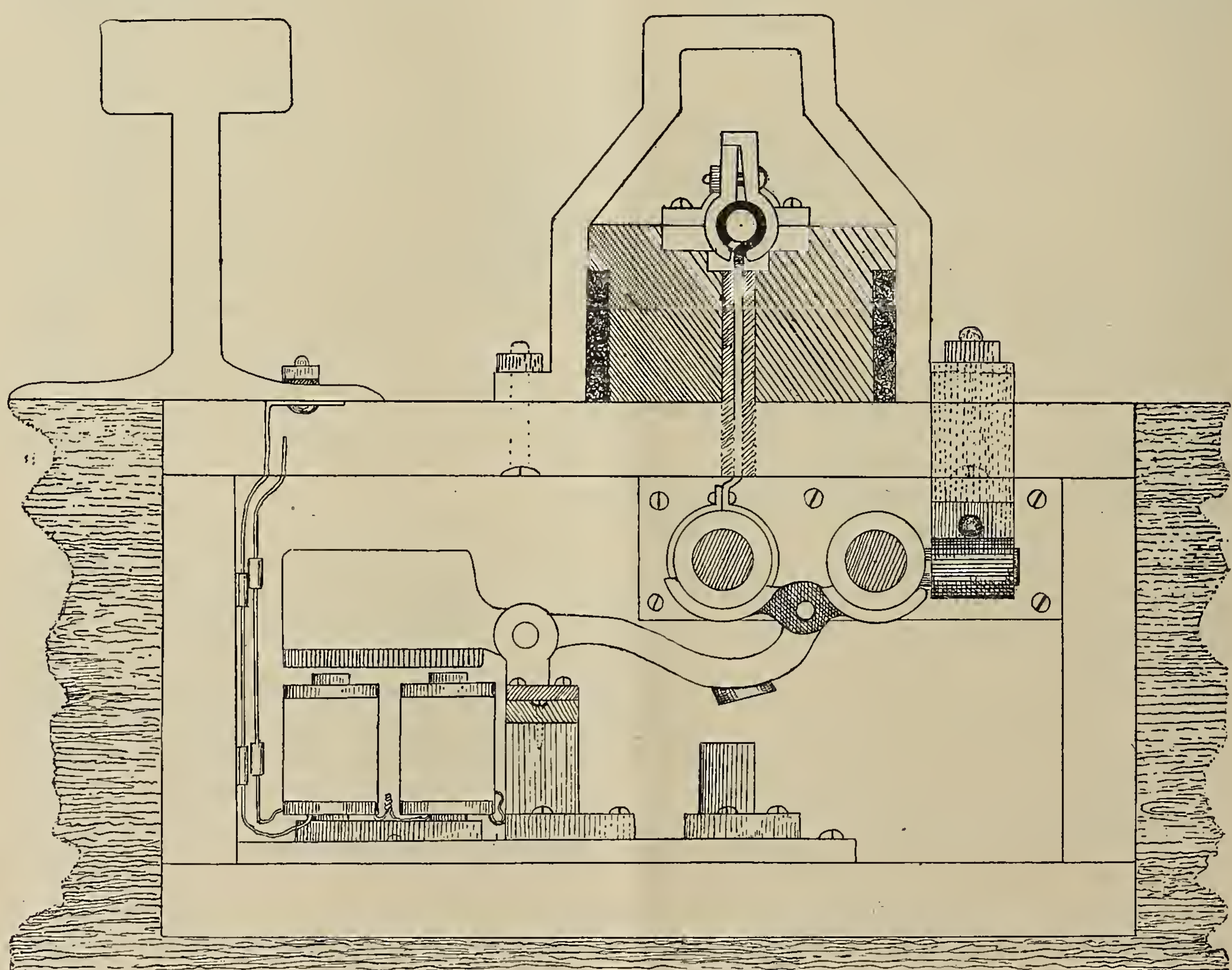


Fig. 5.

also the position of the yoke when the electromagnets are energized, the common service rails and connecting wire, these are the conductors through which the generator on the car transmits its current to the solenoids or electromagnets, which operate the armature that makes contact through the yoke with the connecting pieces over which the dynamic current passes to the third rail. When the magnets cease to be energized the armatures drop to the permanent magnet, thus breaking the circuit in the dynamic current, and by said magnets held in position.

happen to be above. The track then becomes alive and remains so until the car moves on to another section of the track.

The writer's experience has showed him that the system depends greatly for its success, from a practical point of view, upon the reliablity of the electromagnetic device; and, from a commercial point of view, upon the cost of installation which though high is apt to be accepted with resignation if the road meets the exigencies of city traffic without failure.

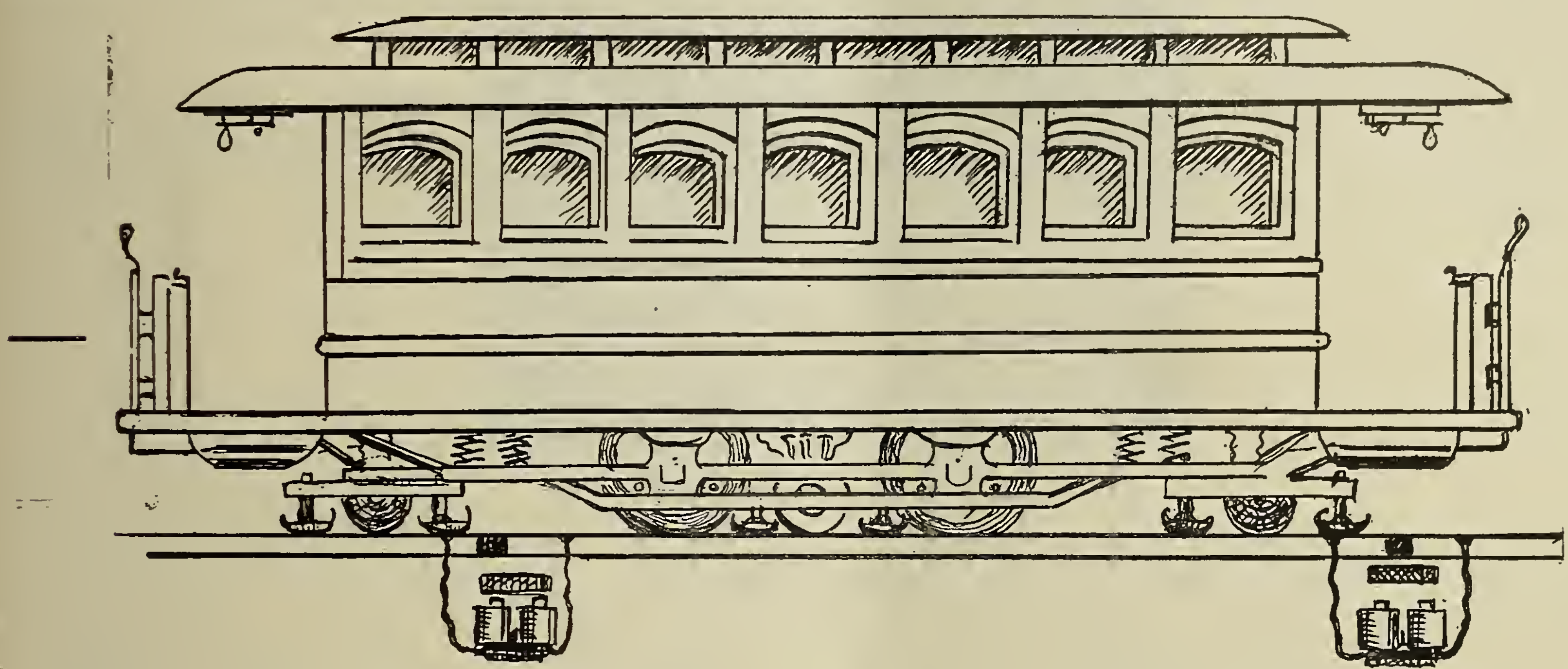


Fig. 4.

Figure 2 is a side elevation of trollies used in the system.

Figure 3 is a transverse vertical section of the same.

Figure 4 shows a common street car and with figure 5 exhibits a line of one side of the railroad, and manner of uniting the rails in series, through which the generator on car transmits its current to the solenoids to energize their cores. Conditions may arise where this form may be in requisition.

Figure 6 is an electric locomotive operated by the Osborn system, showing position of trollies and sectional rails for long trains, as on a steam railway. These several ways for operating street cars may also be performed through the agency of three narrow metallic strips secured to the surface conduit in which these solenoids, armatures, and contact pieces are situated, and all within the claims and scope of this company's patents.

The sum and substance of this system is the principle of rendering the devices beneath the roadbed automatically active in any given section of the road the car may

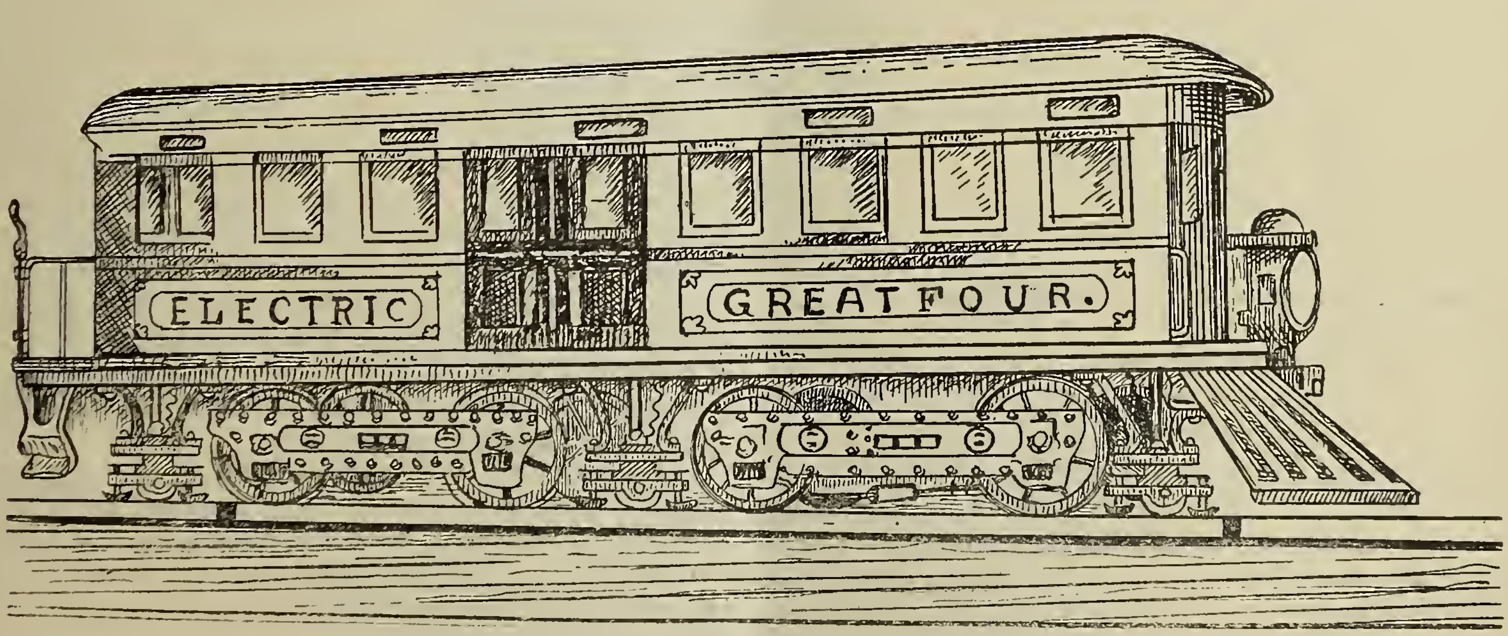


Fig. 6.

THE INTERNATIONAL THERMAL UNIT.

According to the "Scientific American," at the recent meeting of the British Association the electrical standards committee provisionally approved a set of propositions relating to a thermal unit, and for the purpose of inviting international discussion of the question, proposes to send a copy of the propositions to representative bodies throughout the world. These bodies will be invited, says the "Electrical World," to take what action they may deem most desirable, with the view to bringing about international agreement on the matter. The propositions are as follows:

I. For many purposes heat is most conveniently measured in units of energy, and the theoretical C. G. S. unit of heat is 1 erg. The name joule has been given by the electrical standards committee to 10^7 ergs.

For many practical purposes heat will continue to be measured in terms of the heat required to raise a measured mass of water through a definite range of temperature.

If the mass of water be one gramme and the range of temperature 1° C. of the hydrogen thermometer from 9.5° C. to 10.5° C. of the scale of that thermometer, then, according to the best of the existing determinations, the amount of heat required is 4.2 joules.

It will, therefore, be convenient to fix upon this number of joules as a secondary unit of heat. This secondary thermal unit may be called a "calory.".

Accordingly, for the present a second proposition is:

II. The amount of heat requisite to raise the temperature of one gramme of water 1° C. of the scale of the hydrogen thermometer at a mean temperature which may be taken as 10° C. of that thermometer is 4.2 joules.

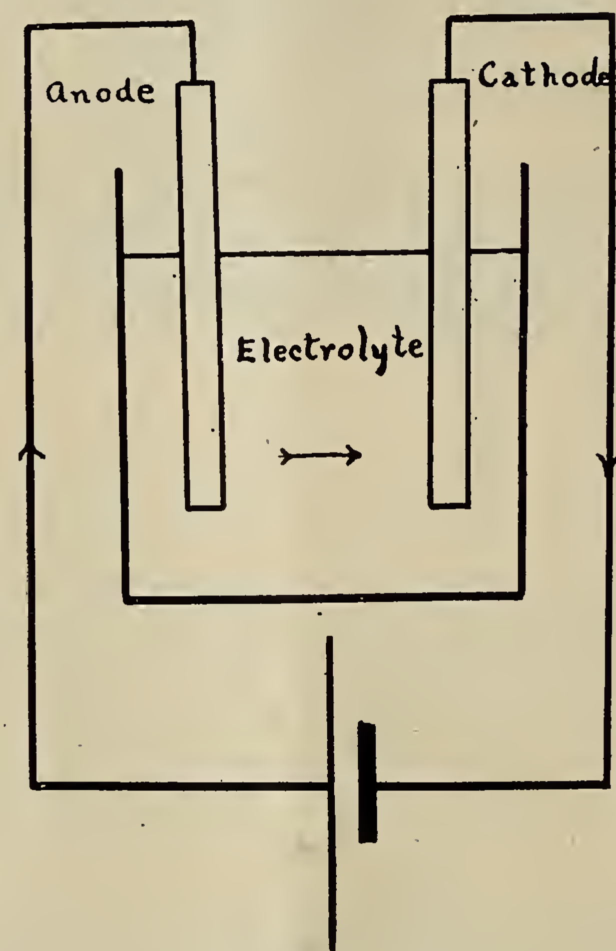
If further research should show that the statement in II. is not exact, the definition could be adjusted by a small alteration in the mean temperature at which the rise of 1° takes place. The definition in I. and the number (4.2) of joules in a calory would remain unaltered.

The more expanded use of these processes leads to the purification of ores by electrolysis, the extirpation of microbes and microscopic organisms from drinking water, and the treatment of sewage for the purpose of rendering it harmless from a hygienic standpoint and useful as a renovator of the soil.

The smelting of ores and the treatment of aluminum can almost be classed under the same head. The production of fine gold and silver ware, executed by the process of plating on glass, has created a new field in the application of electroplating to the higher arts.

And the sub-department of electrotyping in all its phases has established a firm footing in publishing and engraving firms.

Almost 100 years ago the first experiments in the depositing of metals was performed in a small way, and from then on until a period of forty years had passed the germ of growth was stayed.



Theory of Electrolysis.

ELECTROPLATING.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

PART I.

The essential requirements for electroplating are cleanliness and a slight knowledge of chemical reactions. There is much that may appear to be beyond the scope of the home experimenter in this work, but such is not the case, as the apparatus used is within the means of every careful worker.

The study of electrolysis is based upon the curious though familiar fact that the passage of a current through a solution made of the salts of any metal will cause a deposit to occur.

This deposit may be brought about by the current from a few small primary batteries of closed circuit type or the heavy current of a plating dynamo built and used especially for this purpose. The growing industry of electroplating has made this quite an important branch of the commercial arts. The most common department of plating is comprised under the heads of copper, nickel and silver plating.

The gradual evolution of the different methods now prevailing grew from that time on.

Electroplating is the process of depositing a layer of metal on another body by an electric current.

One of the simplest forms of plating coming into notice, and one within the scope of the reader, is the process of copperplating.

Copperplating.—A solution is made of pure water and crystals of sulphate of copper.

The copper crystals or bluestone, as it is commonly called, is dissolved in sufficient water to make a semi-saturated solution. The addition of a few drops of sulphuric acid greatly improves the conductivity of the bath. About four tumblerfuls of water to one-half a pound of crystals will suffice.

A plate of pure copper is secured to the positive pole of the battery or dynamo, and the object to be plated to the negative pole. The passage of the current will cover the object with a copper film of gradually increasing thickness.

The purity and excellence of the deposit is subject to the following conditions :

Pressure in volts.
Current in amperes.
Condition of solution.

Pressure in volts in copperplating is determined by the condition and nature of the bath.

A copper solution acidulated and a copper cyanide require the following:

	Volts.
Copper acid bath,	.5 to 1.5
Copper cyanide bath,	.3 to .5

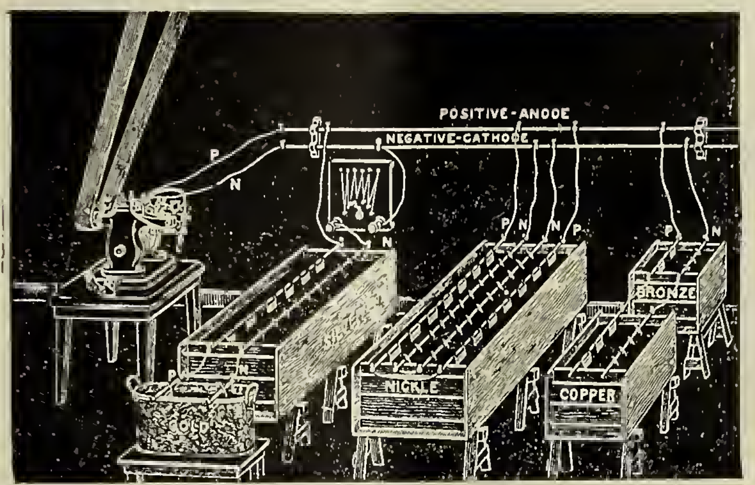
The following facts in relation to copperplating will prove of value. The *electro-chemical equivalent*, or the amount of metal deposited by one ampere per second, is the basis of this table.

A coating of oxide sometimes forms from exposure to the air; both can be removed by using two baths for cleansing, as mentioned below:

Stripping or acid bath.
Cleansing or lye "

PART II.

The stripping bath if used for a dip or two of the metal to be plated will remove all traces of oxide; in fact, it will



Method of Connecting up.

SIMPLE PLATING CELL.

COPPER.

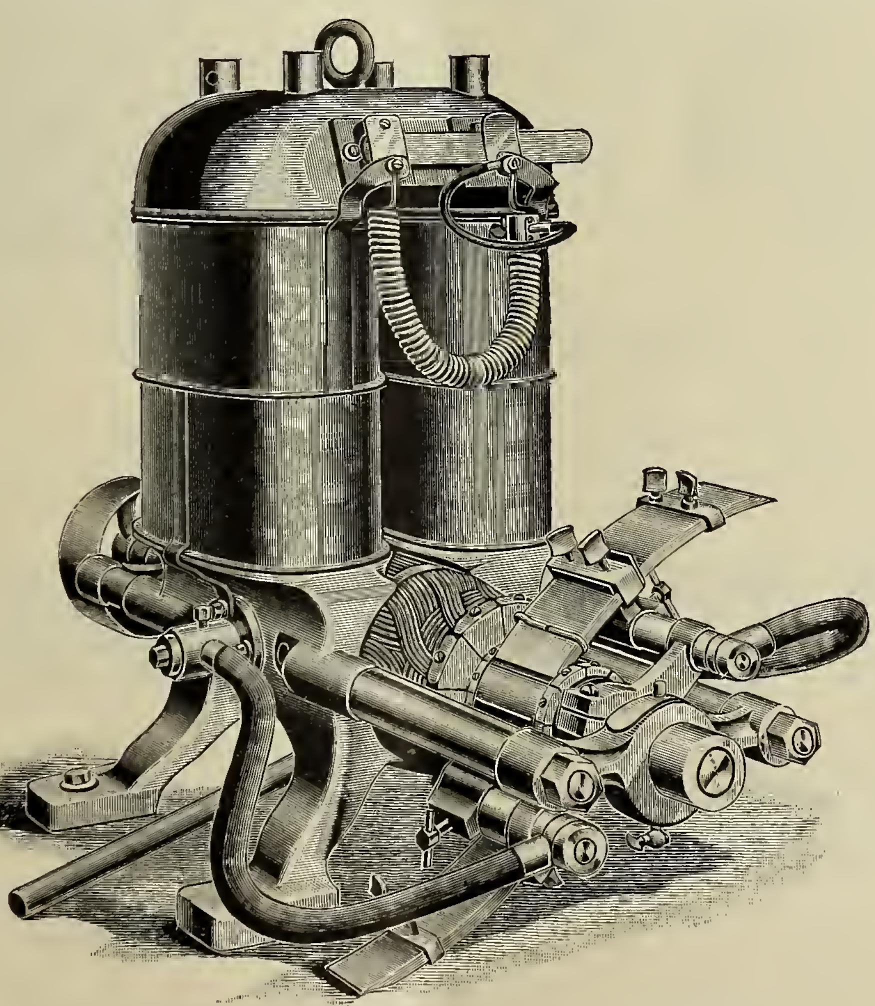
Current				Weight in Grammes.
Current	1	ampere deposits	.000326	per second.
"	1	" "	.01957	" minute.
"	1	" "	1.17390	" hour.
	851.8	" "	1.	kilogramme per hour
	386.4	" "	1.	pound per hour.

The further facts worthy of consideration depend upon the extent to which the plating is done for their usefulness.

act so successfully on a plated object that it will remove all the deposited metal in short order. The alkali bath of caustic soda attacks any and every form of grease, oil, etc., leaving the object clean and ready for a second cleansing in a vat of live water.

Metal, especially copper, can sometimes be deposited on a body due to the fact—the relation existing chemically will cause a coating of pure metal to form.

Bright steel dipped into a copper solution receives a red coat of copper, the metal being precipitated without the



Arnoux and Hochhausen Plating Dynamo.

When a great quantity of copper is to be deposited each day, the following is a valuable fact to remember:

One hundred pounds of copper deposited in a day of ten laboring hours would require 3,864 amperes of current.

To return to the process and precautions necessary—the material to be plated must be thoroughly free from grease and oil.

aid of any current. *A weak current* will deposit upon the cathode or negative pole a deposit that is inclined to be brittle and crystalline in nature.

A strong current will cause a deposit that appears to be composed of disintegrated particles of copper. They are black and powdery and of no use at all, though consisting of pure copper.

The proper current will give a characteristic deposit of tough and close-grained copper.

The determination of the proper current can be obtained by noting the current in amperes for a given surface of copper and regulating it as the table indicates.

Proper current for deposit.

	Amperes per 100 Sq. inches.
Copper cyanide bath,	2 to 3
Tough deposit,	1.5 to 4
Very tough,	4 to 10
Very solid,	10 to 25
Solid, but sandy at edges,	50 to 100

For weak solution and a strong current a black deposit ensues, and gas is liberated at the cathode pole.

For a strong solution and a weak current the deposit is crystalline and useless.

It is sometimes considered good practice to connect a number of vats together in series; in such a case the volts required for the total number of baths on the basis given must be applied. For ten baths of three volts each 30 volts pressure is necessary. Plating can be done with a solution and a carbon anode.

If such were the case, however, the anode being unable to waste, the liquid would suffer, becoming greatly weakened, and unless strengthened by the addition of more salts ultimately losing all its metal, whether copper, nickel, silver or gold.

It is the practice to refine copper by using large vats in series with each other, as described. A dynamo of the requisite pressure sends the current through the series.

Huge blocks of the crude ore are connected to the positive pole and used as anodes.

The cathode is a thin plate of copper. Only pure copper is deposited upon it, and this is allowed to thicken until it is in the shape of thick plates or large ingots.

They are taken and rolled into wire or used for miscellaneous purposes, being about 96 to 98 per cent. pure copper.

The sediment or sludge is retained and the metal it holds, either in the shape of salts or particles, is recovered.

About three dollars' worth of gold and silver is obtained from each tank after a few days' run. The richness of the copper ore in these valuable impurities greatly varies, being from a dollar to three or even more per ton if the ore is rich.

Quicking a piece of metal is the process of covering its surface with mercury before plating. A solution made by dropping mercury into nitric acid will be useful for this purpose, if applied to the surface of the object.

When the article has received a coating of sufficient thickness it is removed from the bath and dried in sawdust, after being washed. It is then *buffed*, or, if the surface is rough, exposed to the action of a circular brush having wire instead of hair or bristles as its effective portion.

Scratching is the name applied to such work, and between the two the object becomes perfectly smooth and endowed with a bright lustre. To perfect the work further and produce a surface of excellent quality, the process of *burnishing* is carried on.

This is done by means of a smooth curved surface applied to the deposit very briskly and with considerable pressure. An object that has been covered with a coating of metal under which exists a surface of oxide, is likely to *peel*. The way to eradicate this trouble is to treat the surface beforehand to a dilute solution of acid, or to give it a rapid dip in the stripping bath.

Certain classes of solutions do not conduct electricity very well, such as tetra-chloride of zinc for instance; nitrates in solution are very difficult to handle because of their rapid oxidizing power. The deposit of metal can only be obtained by the greatest care. The free acid released by electrolysis is the direct cause of the trouble.

The best solutions are made up of sulphates or cyanides of the metal.

An excellent formula for a copper sulphate solution is as follows :

Acid copper solution.—Prepare a saturated solution of copper sulphate; warm water will be very effective in this respect for the rapid preparation of an intense solution.

Take 1 gallon of saturated solution.
1 quart of water.
1 ounce sulphuric acid.

The preparation of an alkaline solution for deposition upon iron and zinc is covered by the following:

Alkaline solution of copper.—Mix a solution of copper sulphate and cyanide of potassium together. A precipitate falls to the bottom of copper cyanide. The precipitate is washed in pure water and strained, then redissolved in a solution of cyanide of potassium and water.

A cyanide of potassium solution is made by dissolving two pounds of cyanide to one gallon of water.

After the copper solution has been obtained by the above method, two ounces of cyanide is added to each gallon of copper solution.

This solution works but at 100° F., but a heavy current will cause a good deposit at 30° F.

In nickelplating certain precautionary measures are adopted to insure good results. A very strong solution will be as injurious to the deposit as a heavy current. The solution and current therefore determine the quality of the deposit, while it is known that about 30 to 40 grains per hour of copper express the limit for good plating; the conditions of nickelplating forbid a similar statement.

Nickel is best deposited from a salt composed of two in active conjunction—salts of nickel and ammonium. The processes of preparation are two-fold; when separately obtained they are mixed as described.

(I.)

Sulphate of nickel.

3 parts nitric acid.
1 part sulphuric acid.
4 parts water.

Dissolve in this solution two pounds of nickel to each gallon and gradually heat until the nickel is entirely dissolved. When this occurs add one-quarter of its volume of hot water and filter.

(II.)

Ammonia solution.—Dissolve sulphate of ammonia in hot water until the solution is saturated; about four pounds to the gallon will be sufficient.

The two solutions of nickel and ammonia are mixed in equal quantities.

The precipitate that falls when both are mixed is then washed in a portion of the ammonia solution.

This sediment is the plating salt, the double salt of nickel and ammonia.

For use mix three-quarters of a pound of this salt to one gallon of water. The solution must be chemically neutral. This is accomplished by testing with litmus paper.

The paper is simply dipped in.

If the litmus paper becomes red add sulph. ammonia.
" " " " blue " " nickel.

The wave length of Roentgen rays has been ascertained by Dr. Fromm, of Munich, at fourteen millionths of a millimeter, that is about seventy-five times smaller than the smallest wave length for light. This determination was based upon interference phenomena observed by Dr. Fromm, says Prometheus.—Scientific American.

THE MODERN POWER-HOUSE.

REPORT OF COMMITTEE BY RICHARD McCULLOCH.

In beginning a paper of this kind it is usually considered proper to start with a sort of historical review, but in this case we are immediately struck with the fact that, unlike most modern institutions, the eventful history of the street-railway power-house has been condensed into the last few years. The conditions, the general design and the greater part of the machinery itself have been evolved during the last ten years. All of these have changed rapidly, and the manager who now deplores as antiquated a power-house built six years ago, with the best existing machinery and in the light of the most approved practice, can say with Cicero, that it was not his fault, but the fault of the times.

It may be readily seen that there are two standpoints from which the design of the power-house may be viewed. That of the one, who strives that the general plan that each machine, and that every arrangement shall tend solely towards the cheapest possible production of power; and that of the other who, while appreciating the position of the former, desires also that nothing shall enter into the design which will materially affect either the simplicity or the reliability of the plant. The cost of power on a large road is about ten per cent. of the total operating expenses, and it is almost a self-evident fact that the use of any apparatus which might produce unreliable service, and thus impair the receipts and ruin the prestige of the road in order to save a small percentage of this cost of power, would be very bad business policy. The first criterion of any machine installed in a power-house should be absolute reliability, and the second, economy.

LOCATION.

A great deal has lately been written concerning the proper location of power-houses and formulæ, and graphical methods for determining this point have been derived; but we doubt very much whether any street-railway power-house has ever been located either by graphics or by the differential calculus. Unfortunately it usually happens, especially in cities, that the electrical centre of the distribution system falls in very valuable ground entirely unsuited for a power-house location, and the final location is very often influenced by the extremely unscientific fact that the railroad company owns that particular piece of ground and cannot find a purchaser for it. In selecting a location it is very important that a large power-house should be placed on a railroad track, so that coal may be readily and cheaply delivered, and it is very desirable, that the location should also be on some water supply, in order that condensing engines may be used, unless the conditions will warrant the use of self-cooliug condensers. If a location fulfilling these conditions may be found somewhere near the electrical centre of distribution, it is an ideal spot for a power-house; but if in order to secure coal and water it must be moved from this point it should, if possible, be moved in the direction of future extensions of the street railroads. There are cases where power-houses cannot be located on the steam-railroad tracks, but the only excuse for such a location is where the interest on the cost of copper feeders running from the steam-railroad tracks to the centre of distribution would greatly exceed the cost of hauling of coal in wagons.

(To be continued.)

New Orleans, La.—The idea of changing the animal power, which is now required to operate three miles of its lines, to electric motors, is being considered by the New Orleans Traction Co. Address, C. D. Weyman, general manager.

Read before the American Street Railway Association.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—SPECIFIC INDUCTION.

Hartford, Jan. 5, 1897.

Dear Sir:—Having frequently heard the expression "Induction" used, I take this opportunity of inquiring whether it has but one meaning or many, and, if many, what they are?

By answering this you will greatly oblige,

Yours truly,
F. E. Simpson.

(Kindly include the term Specific Induction).

(A.)—The word induction has several meanings.

(1). A charged body affects the mutual body by static induction.

(2). A varying current in a wire excites a current in a neighboring circuit by mutual induction.

(3). A varying current in a wire excites within its own circuit additional currents by self-induction.

(4). The number of lines of force per square cm. is called the specific induction of the iron.

(Q.)—POWER FROM COAL MINES.

Pittsburgh, Jan. 8, 1897.

Dear Editor:—Kindly inform me whether the scheme of using coal at the mines for producing power which could be sent broadcast to the adjoining towns is new or not? I have an idea that power could be generated there very cheaply and a great deal of expense saved by the erection of a large plant at the mine. Kindly give your opinion to

A Constant Reader.

(A.)—The idea is not new. It is valuable and may in the future be carried out. Coal at the mine is very cheap; but many lighting and power concerns now use either pea coal or culm. Thousands of tons of this are still to be consumed, and the price is low. The cost of fuel is not the first element of consideration at present.

(Q.)—WHY X-RAYS BURN.

Newark, Jan. 8, 1897.

To the Editor of Inquiry Column:

Dear Sir:—Kindly inform me whether the burns ex-experienced by those using Crookes tubes are caused by an electrical or thermal condition? The burns I have seen are so like sunburn that I doubt whether they are due to anything other than heat rays. I would be greatly obliged for your criticism of this opinion.

Yours respectfully,
L. F. Martens.

(A.)—The burns that users of Crookes tubes are affected with are similar to heat burns. In all likelihood the Crookes tubes give issue to X-rays and heat rays in conjunction with each other. There may be some other influence at work that exercises a strong physiological effect upon the flesh, but as far as is known none are cognizant of its presence. An electrification alone, the peculiar breeze blowing near powerful Crookes tubes, can hardly be the cause of such severe inflammation.

Roanoke, Va.—The city council has instructed the ordinance committee to prepare an ordinance on the question of erecting an electric lighting plant, which is to be submitted to the voters, and the city engineer has been instructed to prepare plans and estimates. Address the mayor for further information.

POSSIBLE CONTRACTS.

Demapolis, Ala.—A franchise for the erection of an electric light plant has been granted to the Demapolis Electric Light and Power Co., by the city council.

Sheffield, Ala.—The water and electric light plants of the Electric Light and Water Company has been leased by J. A. May, of Tecumseh, and C. B. Ashe, of Sheffield, who will thoroughly repair the same incidental to their early operation.

Fernandina, Fla.—The advisability of erecting a new electric light plant is being considered by the city. Address the mayor.

Augusta, Ga.—A charter will be applied for by The Moore-Edenfield Electric and Manufacturing Co., who will continue the business of Moore & Edenfield, manufacturing dynamos, motors and supplies. George P. Welch, treasurer, and R. J. Edenfield, general manager.

Savannah, Ga.—The Savannah Electric Railway has been purchased by Herman Myers for $211,000, acting for the majority bondholders. The property will be improved at a cost of from $75,000 to $100,000; among the improvements being the erection of a new $50,000 power house, which will be equipped with the latest modern machinnry; the track will be relaid and new rolling stock added.

New Orleans, La.—About $100,000 will be expended by the New Orleans Traction Co. in improvements in establishing its own power house.

Cortland, N. Y.—The village of Homer is becoming so thoroughly dissatisfied with the electric light service given by the Traction Company that they contemplate the erection of a plant by home capital for the purpose of supplying lights.

Penn Yan, N. Y.—The committee having in charge the working up of the new electric railroad that is to be built between Penn Yan and Branchport reports that the prospects are good, and that work on the same will commence in the early part of spring.

Charleston, S. C.—The erection of the power house of the Charleston Street Railway Co. will be shortly commenced.

Petersburg, Va.—The city has the erection of an electric light plant for street lighting under consideration. Address the mayor.

Raleigh, N. C.—The erection of an electric light plant for lighting the streets is being contemplated by the city. A company, with J. C. Drewrey as chairman, has been appointed to investigate.

NEW CORPORATIONS.

Gainesville, Ga.—The Gainesville and Chattahoochee Power and Manufacturing Co. has been incorporated by C. C. Sanders, J. W. Bailey, Z. T. Castleberry, G. W. Walker and S. C. Dunlap. Capital stock, $50,000; to develop and utilize the water-power of the Chattahoochee River; also to erect an electric power plant, with all necessary machinery for generating electricity by water and otherwise, and to erect and operate a system of electric lights for public and private use.

Albany, N. Y.—The New Paltz and Wallkill Valley Railroad Company has been incorporated to operate a street surface electric road, nine miles long, from the Poughkeepsie Ferry at Highland, N. Y., along the New Paltz turnpike to the Wallkill River at New Paltz, Ulster County. Capital, $150,000; directors: Hugh H. Douglass and G. Howard Harman, Boston; Paul Shaffer, Charles G. M. Thomas, James F. Reid, Joseph H. Devoe and George E. Woods, New York; Henry M. Brundage, Port Chester, and William G. Hoyt, Garden City. The company's principal office will be at 71 Broadway, New York.

Brooklyn, N. Y.—A certificate has been filed with the Secretary of State, setting forth that the Edison Electric Illuminating Company, of Brooklyn, has increased its capital stock from $3,750,000 to $4,000,000, consisting of shares of $100 each. The amount of capital stock paid in is $3,750,000, and the debts and liabilities of the company are placed at $1,250,000. The directors include Ethan Allen Doty, Edwin Packard, Darwin R. James, George Foster Peabody, Julian D. Fairchild, Frank L. Babbott, Charles E. Crowell, E. LeGrand Beers, George H. Southard, Martin Joost and Lowell M. Palmer.

NEW TELEPHONE COMPANIES.

Baltimore, Md.—The Drawbaugh Telephone and Electrical Appliance Co., Limited, of Washington, D. C., has been incorporated by B. Butterworth, of Cincinnati, O.; J. E. Blair, of Gettysburgh, Pa.; A. G. Davis, of Baltimore; H. D. Walbridge, of Washington, D. C., and others; to manufacture telephones and appliances patented by Daniel Drawbaugh, of Pittsburgh, Pa.

Montpelier, Vt.—The People's Telephone Company (incorporated) was organized here today, and will begin the work of installing a telephone system in Addison, Washington, Chittenden, Lamoille, Orange, Franklin and Windsor Counties. The officers chosen were as follows: Directors, Henry James, E. C. Hooker, C. D. Robinson, of Waterbury; George H. Almon, of Montpelier, and N. N. Power, of New York. Henry James was elected president; C. D. Robinson, vice-president; E. G. Hooker, treasurer; and George H. Almon, secretary and general manager.

TELEPHONE NOTES.

Savannah, Ga.—The Southern Telephone and Telegraph Co. will ask the city council for a franchise to construct a telephone system in Savannah.

St. Louis, Mo.—H. J. Hanford, general manager, is supervising the drawing of plans for the telephone plant of the newly-formed Kinlock Telephone Co.

Philadelphia, Pa.—The Keystone Telegraph and Telephone Company will soon commence the erection of poles in the various towns throughout the Schuylkill valley.

Rockport, N. Y.—The franchise of the Bell Telephone Company has been renewed by the common council. The company agrees to give the city six free telephones, the use of poles for fire alarm service, and also to put its wires underground upon notice from the city authorities.

Islip, L. I.—A telephone company will shortly be organized in this village by George C. Randall, a local electrician. The lines will reach from Patchogue to Babylon, taking in all the villages between the two places, and extending as far north as the villages on the main line of the Long Island railroad.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued November 17, 1896.

571,351. Electromagnetic Signal Receiving Instrument. S. D. Field, Stockbridge, Mass. Filed Aug. 11, 1896.

571,362. Magnet Separator. J. B. Hamilton, Springfield, Mass. Filed Dec. 5, 1893.

571,363. Electric Governor for Water-wheels. W. W. Handy, Baltimore, Md. Filed June 19, 1896.

571,399. Telephone Transmitter. D. N. Rowan, Irvington, N. Y. Filed Dec. 10, 1895.

571,420. Commutator-brush. A. K. Warren, New Brighton, N. Y. Filed May 16, 1896.

571,435. Electric Railway System. G. J. Forrey, Carlisle, Pa. Filed Feb. 29, 1896.

571,440. Cable Carrier. E. L. Heidenreich and G. Monrath, Chicago, Ill. Filed Aug. 15, 1896.

571,441. Electric Signal Box. W. W. Hibbard, Rochester, N. Y. Filed June 16, 1894.

571,445. Annunciator. F. A. Jennings, Ithaca, N. Y. Filed May 11, 1895.

571,454. Rail Support. W. B. Potter, Schenectady, N. Y. Filed Aug. 25, 1896.

571,455. Rail Support. W. B. Potter, Schenectady, N. Y. Filed Aug. 25, 1896.

571,460. Primary Battery. S. N. Smith, Minneapolis, Minn. Filed Nov. 16, 1895.

571 462. Field Magnet Structure. D. P. Thomson and H. Geisenhoner, Schenectady, N. Y. Filed Aug. 18, 1896.

571,463. Controlling Electric Arcs. E. Thomson, Swamscott, Mass. Filed June 26, 1896.

571,467. Regulating Polyphase Circuits. A. H. Armstrong, Schenectady, N. Y. Filed May 2, 1896.

571,472. Track Instrument. T. B. Dixon, Henderson, Ky. Filed Nov. 15, 1895.

571,478. Alternating-Current Motor. M. Hutin and M. LeBlanc, Paris, France. Filed May 25, 1895.

571,488. Foot Belt. J. W. Madden, Brooklyn, N. Y. Filed July 11, 1896.

571,489. Manufacture of Electrical Resistances. A. J. Marquand, Cardiff, and D. Lowden, Barry Dock, England. Filed June 25, 1896.

571,502. Electrical Elevator. R. Wilson, Louisville, Ky. Filed July 8, 1895.

571,504. Microphone Transmitter. E. A. Barkalow and N. Crawford, Kokomo, Ind. Filed July 31, 1896.

571,507. Electric Signalling System. J. P. Buchanan, Boston, Mass. Filed Feb. 5, 1894.

571,517. Automatic Trolley Switch. L. M. Erb, Leavenworth, Kan. Filed Feb. 29, 1896.

571,539. Electrical Switch Conductor. W. H. Sawyer, Providence, R. I. Filed Aug. 12, 1896.

517,594. Cable Terminal Box. W. H. Johnston, St. Louis, Mo. Filed Sept. 14, 1896.

571,598. Manufacture of Plates for Electric Accumulators. J. Korner, Mannheim, Germany. Filed Jan. 6, 1896.

571,600. Controller for Electric Pumps. F. W. Merritt, Duluth, Minn. Filed Feb. 14, 1896.

571,669. Lightning Arrester. A. DeKhotinsky, Boston, Mass. Filed Sept. 24, 1896.

571,695. Telegraph Switch Mechanism. F. P. Scott, Terre Haute, Ind. Filed March 25, 1896.

571,706. Electric Cable. S. P. Thompson, London, England. Filed July 20, 1892.

571,707. Electric Cable. S. P. Thompson, London, England. Filed July 20, 1892.

571,710. Trolley for Electric Cars. S. F. Tufts, Westbrook, Me. Filed Oct. 9, 1895.

571,723. Electric Gas Lighting Apparatus. C. W. De Mott, Brooklyn, N. Y. Filed May 8, 1896.

571,734. Electric Cut-out. B. F. Rout, Stanford, Ky. Filed March 27, 1896.

ELECTRIC STOCK QUOTATIONS.

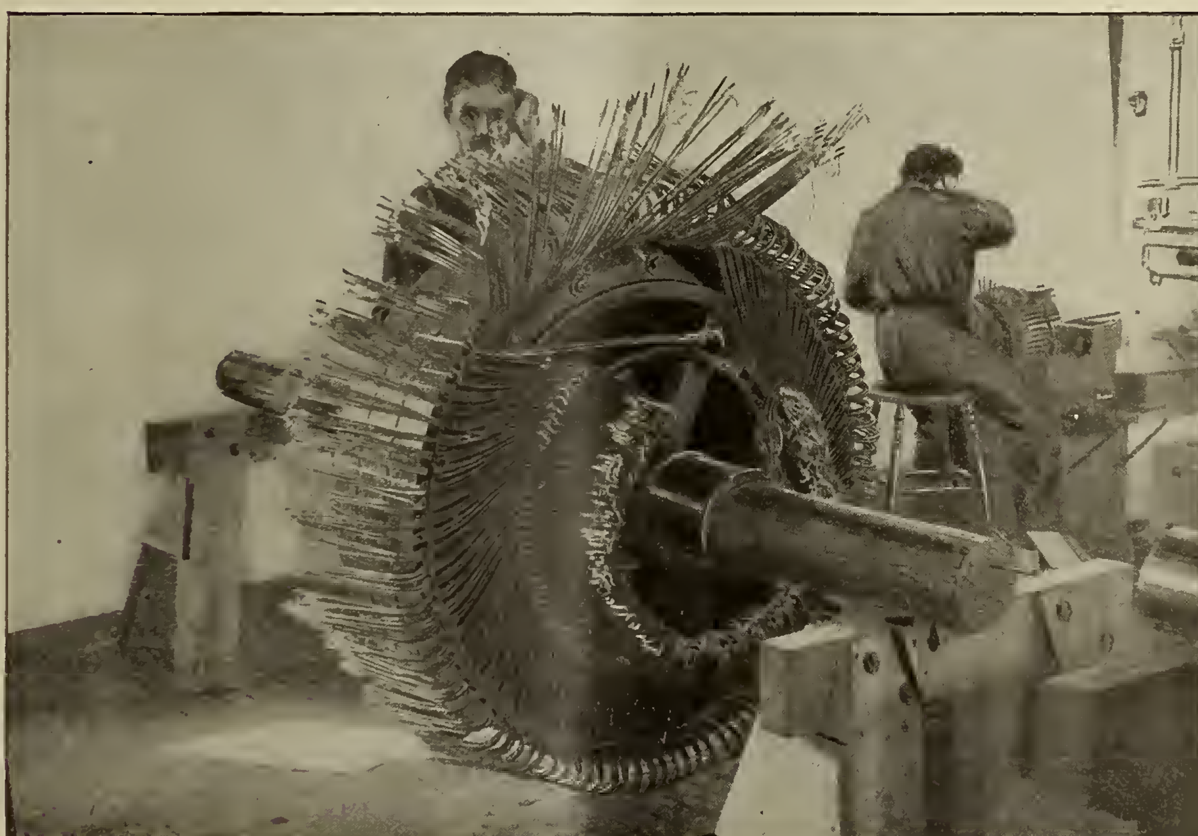
	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	35	38
Edison Illg. Co. (St. Louis),	10	17
Eddy Electric Mfg. Company,	—	19
*Edison Elec. Illg. Co., New York,	103½	104½
Edison Elec. Illg. Co., Brooklyn,	98	100
Edison Ore Milling Co.,	7	10
Edison Elec. Storage Company,	28	29
East End Electric Light Co.,	—	—
Fort Wayne Electric Company,	3	3½
Ft. Wayne Elec. Co. T. Sec. Series A,	3	4
General Electric Company,	34½	35
General Electric Company pf.,	77½	79
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	81½	82
Rhode Island Elec. Protec. Co.,	110	122
Toronto (Canada) Elec. Light Co.,	125	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4¼
Thomson-Houston Welding Co.,	5	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse El. & Mfg. Co., pf.,	50½	52
Westinghouse El. & Mfg. Co., assd.,	24	25

*Ex dividend.

The Electrical Age.

Vol. XIX., No. 5. NEW YORK, JANUARY 30, 1897. Whole No. 507

General View Crocker-Wheeler Electric Company's Works, Ampere, N. J., U. S. A.



"Direct Connected Type," Armature Core, Partially Wound.

THE LATEST OF MODERN APPLIANCES.

The introduction of new methods into shops or engine rooms has always been a cause of dissension to those used to the old and well-trodden paths of conservative engineering.

There is in the growth of certain industries the same chance for critical examination, the same opportunity for discerning elements which bear to it relations that have been honored by the title of evolutionary characteristics in other fields of work. What has been said of any development may well be repeated in connection with the history of electric motors. There was a time when it would have been hard to tell whether it was not doomed to occupy a place beside that of any other new toy—a pretty application of an interesting and to many a fascinating principle. But the old well-worn war-cry may still find its meaning trite if we should individualize the motor's career and say *veni, vidi, vici.*

With the hesitancy that characterizes the preliminaries to great popularity, tbe motor in the United States began to find its sphere of action broadening wonderfully when its recognition as an economical power factor became properly appreciated. The firm to whom much of this advance is due to is the Crocker-Wheeler Electric Co., of Ampere, N. J. They were in the recent past manufacturers of smaller types of motors, but realizing that the time was ripe for greater changes, then enlarged their works and made preparations for a more extensive business in heavier classes of machines.

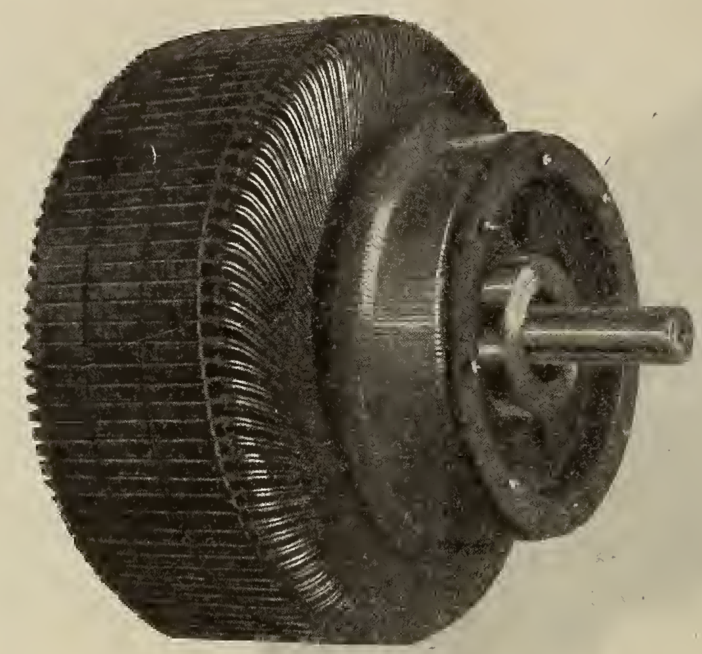
In the different cuts illustrating different parts of machines and various phases of their work the reader will

not fail to be struck with the consistent adherence in almost every case to the belief that direct-connected machines are of the utmost importance to shops, to electric light plants and in a hundred miscellaneous ways, from the standpoint of economy and convenience.

We have no doubt but that it is generally accepted as true that a waste of power occurs in plants and shops that in the course of a year represents a great item of the expenses for that period. It is frequently mentioned as an aphorism that "money is power," but it is likewise time to understand that "power is money." The saving of power is the saving of money, because (without insult to the readers' intelligence), in this and other large cities' power and coal are almost synonymous, and one thousand horse-power hours saved in either an electric light plant or machine shop possesses an equivalent in pounds of coal and therefore in dollars and cents. The element of convenience must meet with some consideration, and from an æsthetic standpoint, the look of a place having in operation direct-connected machinery. In an electric light plant space is saved as well as power, and the general air of neatness is an appeal that is well remembered.

Compactness as a feature of direct connection is inevitably present, with many advantages that an attendant can dilate upon most eloquently.

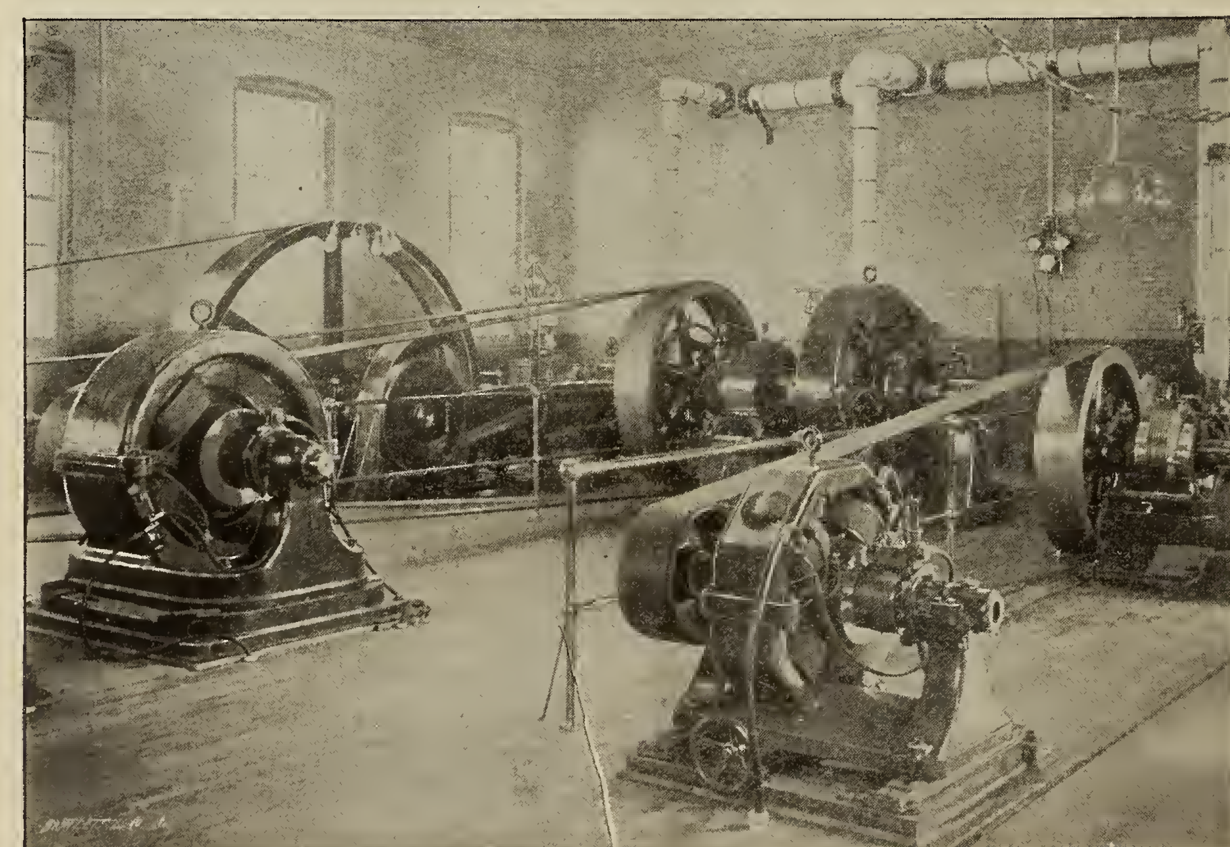
The winding of a 100-K. W. armature and the finished article are represented in the illustrations.



Armature for Direct Connection on Engine Shaft.

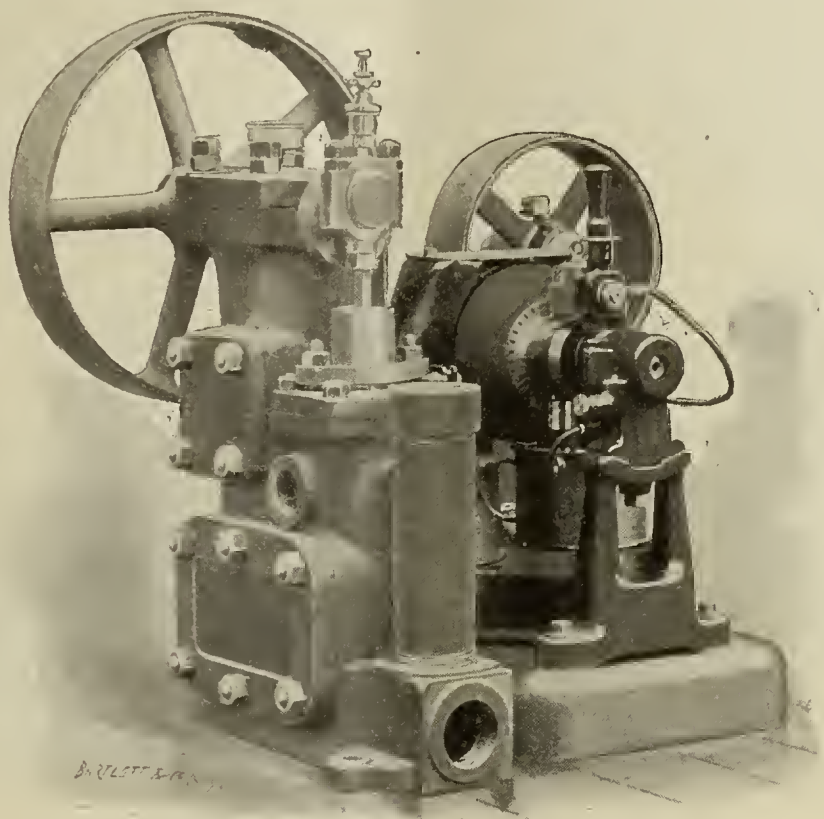
Some smaller direct-connected plants, ranging from four to seven K. W., are represented in the illustration. Likewise a 225 horse-power generator running at 400 revolutions a minute is shown in cut. The peculiar style of winding overlapping conductors, patented by Bradley, in which no bar conductor projects beyond the double laryer that this method creates, is an example of the utmost ingenuity. A 10-horse-power Brake motor with changeable gears is a sample of the nature of the branches of the machine art entered into by the concern.

Another example of the combination effected by the Crocker-Wheeler Electric Co. is that of an armature disk slotter and a motor. The ideal condition for any shop is that of having self-controlling tools, each with its motive power distinct from the rest and actuated by it only when required. The various other applications directly made of the Crocker-Wheeler motor to pumps, hoists,

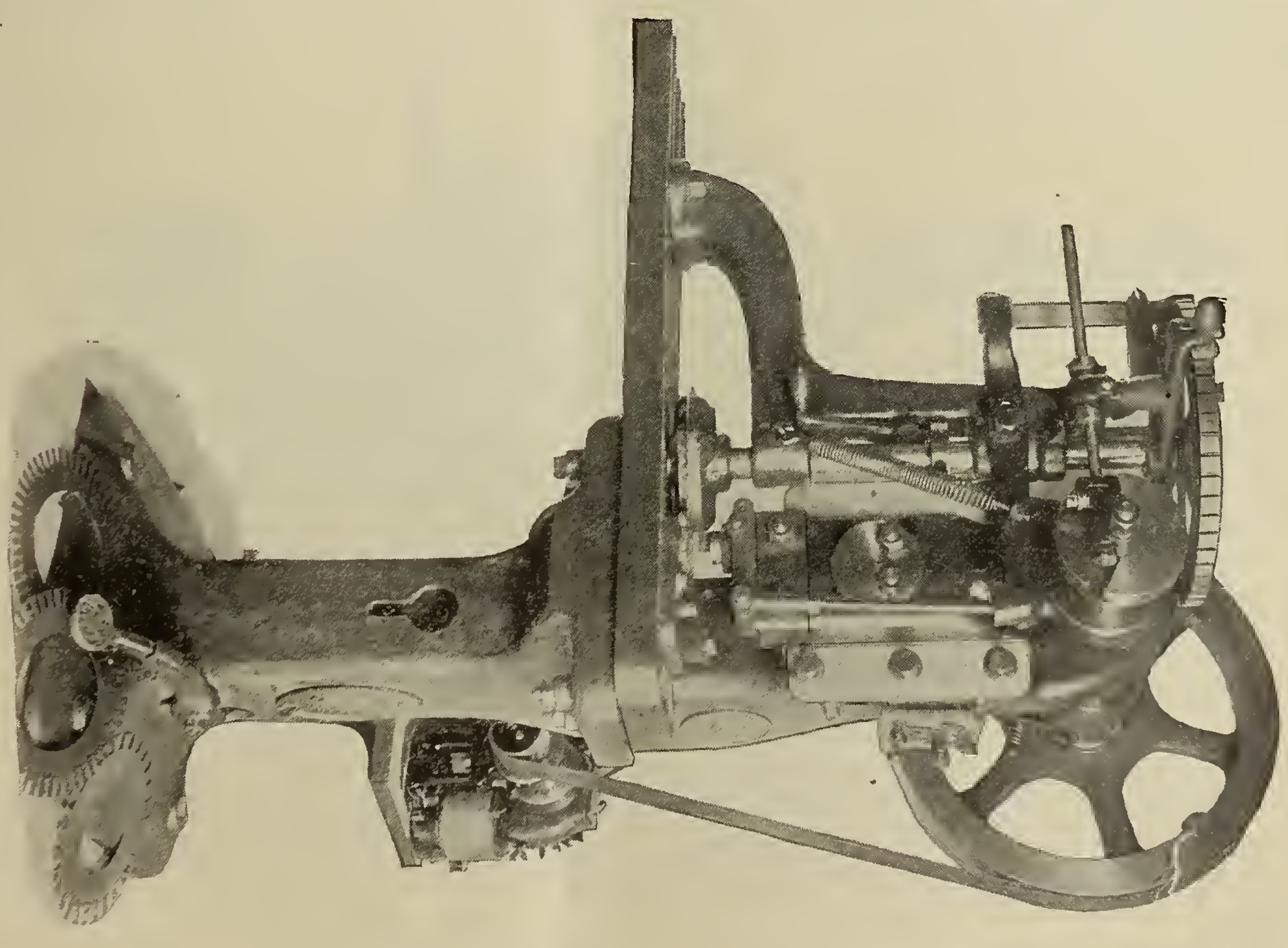


Interior View of Power House, Crocker-Wheeler Electric Company's Works, Ampere, N. J., U. S. A.

etc., need but passing mention here. The future home will regard such devices as commonplaces; today they consider them as wonderful conveniences. If the time arrives when labor will be only that of handling switches and directing power, we think the winning spurs will be worn by those whose efforts are hurrying us forward in this race toward perfection; a pair of golden spurs will hang in the office of the worthiest of competitors, the Crocker-Wheeler Electric Co.



Belted Electric House Pump.



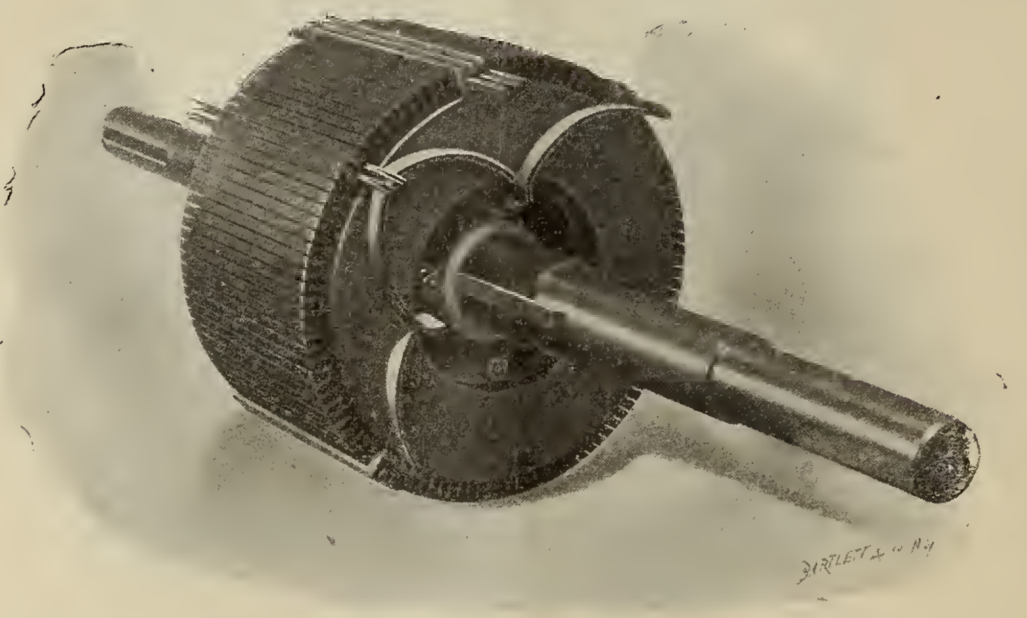
Electric Armature Disc Slotter.

Telephoning from the Sky.—William A. Eddy, Dr. William H. Mitchell and Henry L. Allen sent the first kite telephone and telegraph message in the world over a mid-air wire, sustained by three large kites, at Bayonne, N. J., on December 6, 1896. Morse sounder telegraph signals were also sent by means of a battery. The wire was carried aloft by the kites beyond three lines of trees, two roadways, one line of fire alarm telegraph wires, one line of regular telegraph wires and a house. A red lantern was attached to an end of wire passing through a pulley, held at a height of about five hundred feet, and paid out upward and beyond the intervening obstacles. When the lantern had been carried over the line of Lexington avenue it was slowly lowered, carrying the wire with it to the earth, where Dr. Mitchell soon established ground connections at each end of the wire, when the first telephone message was received by Mr. Eddy. Dr. Mitchell's voice was heard with perfect clearness. A telegraph signal by the usual Morse sounder was also successfully transmitted. The telephone messages and telegraph signals were continued about an hour and a half. Those using the telephone were William A. Eddy, Mrs. Eddy, Henry L. Allen, George S. Bogert and F. M. Wilson, all of Bayonne.—Paterson Call.

TELEGRAPHY WITHOUT WIRES.

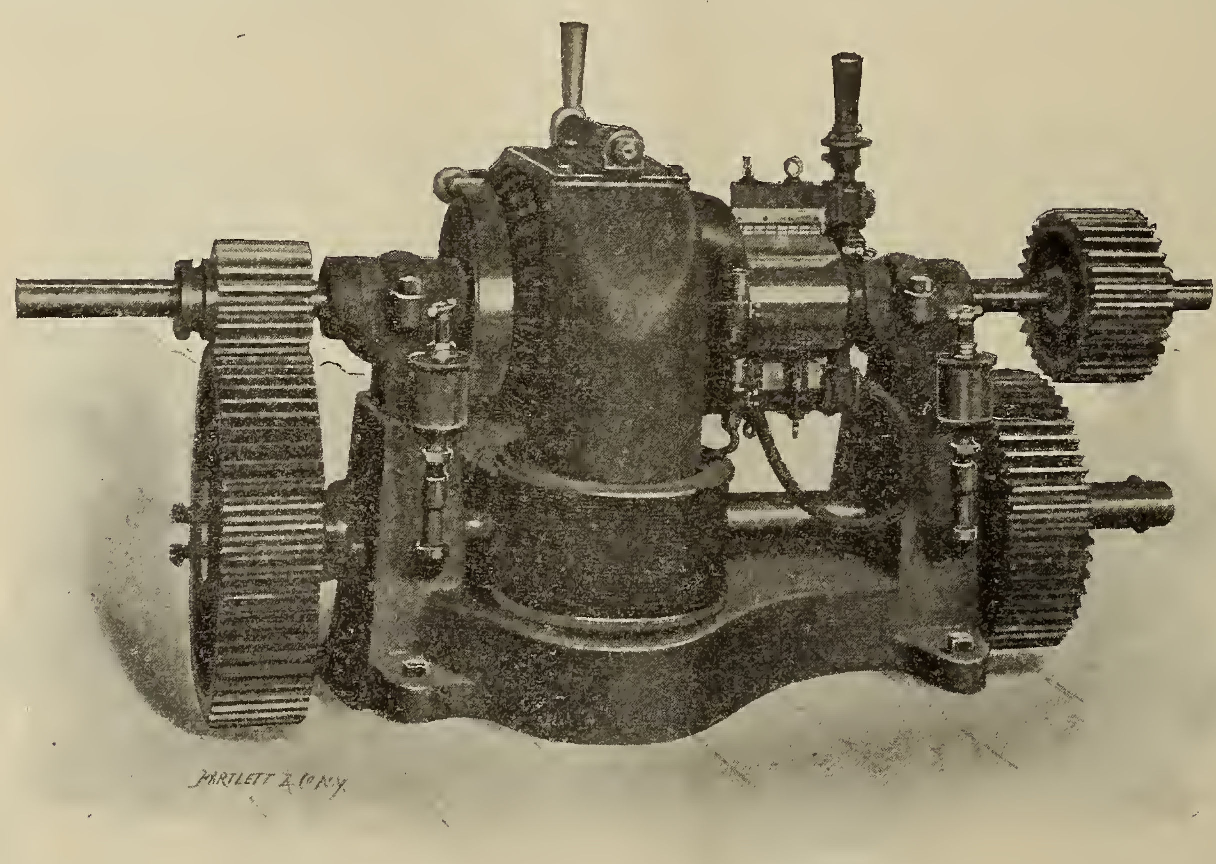
An invention which promises to be of the greatest practical value in the world of telegraphy has received its first public announcement at the hands of Mr. W. H. Preece, the telegraphic expert of the London post-office. During the course of a lecture on "Telegraphy Without Wires," recently delivered in London, Mr. Preece introduced to the audience a young Italian, a Mr. Marconi, who, he said, had recently come to him with a system of telegraphy without wires "which depended, not on electro-magnetic, but on electro-static effects, that is to say, on electric waves of a much higher rate of vibration, not less than 250,000,000 a second; that is, Hertzian waves." These vibrations were projected through space in straight lines and, like light, were capable of reflection and refraction, and, indeed, they exhibited all the phenomena which characterized light.

Telegraphing without wires was, of course, no new idea. Mr. Preece stated that in 1884 operators in the telephone exchange, London, were able from sounds heard to read messages that were in transit from London to Bradford by the telegraph wires. The post-office wires were underground and the telephone wires above ground, and careful experiment showed that this fact accounted for the telegraphic messages to Bradford being read by the telephone company. In 1893 telegrams were transmitted a distance of three miles across the Bristol Channel by induction, and during a break in the cable connecting the island of Mull with the mainland communication was established by means of parallel wires as follows: On the mainland an insulated wire was laid along the ground, earthed in a running stream at one end, the other end being in the sea. Skirting the coast of the island was an overhead wire suited to the purpose. In the course of four days one hundred and fifty-six messages were dispatched.



Two-Circuit Bar-Wound Armature, Showing Connection Details.

The invention of young Marconi solved the problem on entirely different principles. The post-office officials had used it successfully on the roof of the general post-office, and then made a successful test on Salisbury Plain at a distance of three-quarters of a mile. The great difference between the Marconi and the inductive methods of wireless telegraphy was that the former did away entirely with the wires at each end. Vibrations were set up by one apparatus and received by the other.



10 Horse-Power Automatic Brake Motor for Overhead Cranes.

The apparatus shown at the lecture consisted of two plain boxes which were placed at opposite ends of the hall. The current was set in motion in one box, and immediataly a bell was rung in the other. Mr. Preece said that the British post-office authorities had decided to

(Continued on Page 75.)

AN APPARATUS FOR ILLUSTRATING PHASE DIFFERENCES.

READ BEFORE THE SOCIETY OF ARTS, BOSTON, BY LOUIS DERR, M. A.

Republished from the January 20, 1897, issue of the Electrical Review.

When a harmonic electromotive force is applied to a circuit of ohmic resistance R, inductance L and capacity C, there exists in general a phase difference θ between the electromotive force and the resulting current, whose magnitude is expressed by the equation

$$\tan \theta = \frac{Lp}{R} - \frac{1}{CRp},$$

in which p is a quantity equal to 2π times the number of alternations of the current per second. From this equation it appears that θ may be positive, negative or zero, according to the relative magnitude of the two terms. If the circuit consists of an impedance coil, the second term is negligible, θ is positive and the current is behind the electromotive force in phase; if the circuit contains a condenser only, the second term predominates, θ is negative and the current is ahead of the electromotive force.

To show these and other phase relations on a scale suited to lecture room illustration the apparatus here described has been devised by the writer, its operation depending on the principle that, when an electric current is sent through a wire lying perpendicularly across a magnetic field, a force is developed which urges the wire at right angles to both the direction of the field and the current. A powerful electromagnet is mounted on an upright stone base and a wire is stretched across the field between its poles. At the top of the apparatus the wire terminates in the free end of a light metallic hinge, to which a small mirror is cemented. The to-and-fro vibrations of the wire may be observed by a beam of light reflected from the mirror to a screen, the hinge preventing all lateral motion and twisting. The other end of the wire carries a tuning-pin and a device providing a slight angular motion of the whole wire for adjusting the mirror.

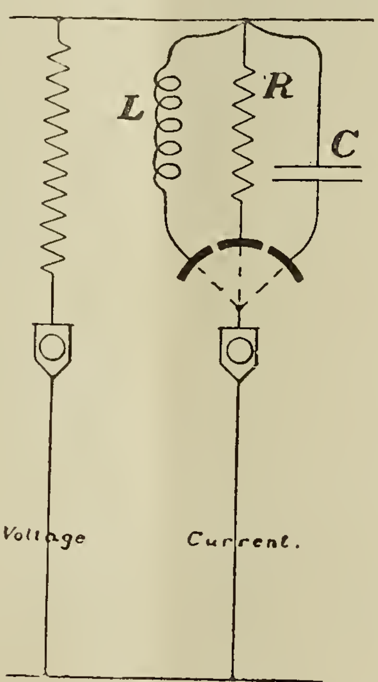


Fig. 2—Switch and Connections. Apparatus for Illustrating Phase-Difference.

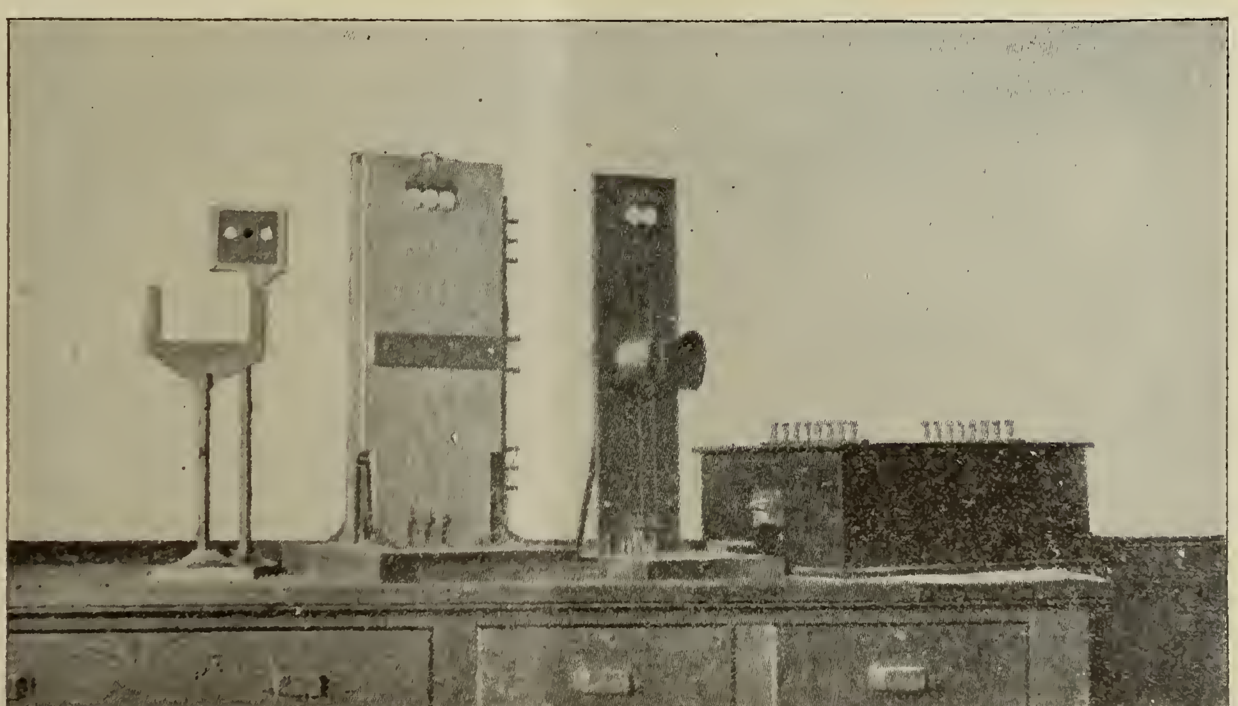


Fig. 3—Apparatus for Illustrating Phase-Difference.

An alternating current sent through the wire urges it alternately backward and forward, and if the tuning-pin is tuned until the period of free vibration of the wire coincides with that of the current, the wire springs into vigorous and distinctly audible vibration, and the spot of light reflected from the mirror on the screen elongates into a vertical line.

That this line is traced by the moving spot is easily shown by putting in the path of the reflected beam a

mirror revolving about a vertical axis and thence reflecting to the screen. On turning the second mirror the successive positions of the spot fall in verticals, and the result on the screen is a very perfect sine curve, a faithful representation of the vibrations of the wire. Figure 1 shows the arrangement of mirrors, using two wires.

With two such wires the observation of the phase difference between two currents is easily made. With everything at rest, the mirrors are adjusted until the spots of light reflected on the screen are coincident. If now the wires are connected into separate circuits carrying currents, the lines of light on the screen remain superposed, the one corresponding to the stronger current appearing slightly longer than the other. On turning the revolving mirror any phase difference between the currents is at once shown by the horizontal displacement of the lagging curve past the other, exactly as text-book diagrams of such curves are drawn.

To observe phase differences between voltage and current under various conditions, one wire is connected to the terminals of the given circuit through a suitable non-inductive resistance. The resulting current will then be sensibly in phase with the applied electromotive force, and the curve on the screen may be taken as representing the changes of the electromotive force itself. The other wire shunted, if necessary, carries the current to be studied. One of the curves on the screen may be colored, and thus identified by putting a slip of colored glass in front of the corresponding mirror. The phase relations between voltage and current in circuits of different character may be conveniently compared by using a three-point switch and connections, as shown in Fig. 2, where L represents an impedance coil, R a non-inductive resistance and C a condenser. The circuits can thus be interchanged as rapidly as desired; and the instant shifting of the curves on the screen, corresponding to the character of the circuit employed and agreeing with the conclusions of a preceding paragraph, is quite striking. With the apparatus here shown a current of one ampere in the wire and a total length of about 30 feet in the reflected beam gives curves on the screen of two feet amplitude.

The angular relations between the currents in a polyphase circuit may be shown to an audience if the necessary number of mirrors is employed; the reactions of condenser and impedance coil upon each other in a circuit adjusted for resonance may be illustrated if a high-voltage condenser of large capacity is available; and the phase relations between the primary and secondary voltage and current of a transformer may be demonstrated. Figure 3 shows two-wire and three-wire apparatus, together with the 17 microfarad condenser and color screens used in the experiments. A foot rule is also photographed to show the size of the instruments. Exact dimensions are not given, as the size of every part may be varied within wide limits.

It should be stated that the results given by the apparatus in its present form are not quantitatively accurate within several per cent., especially if the currents in the wires are not truly sinusoidal. The discrepancies between calculated phase differences and those observed with the apparatus, while unfitting it for precise measurement, do not, however, interfere with its usefulness as an instrument for purposes of illustration.

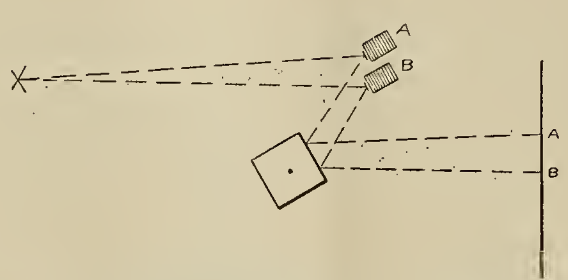


Fig. 1—Arrangement of Mirrors, Apparatus for Illustrating Phase Difference.

PROGRESS IN ELECTRICAL ENGINEERING.

BY ALFRED HAY, B.SC., A.I.E.E.

Probably no other branch of applied science has ever advanced with strides as rapid as those which have characterized the progress of electrical engineering. To some extent this may be accounted for by the fact that whereas most other branches of industry had their origin at a remote date of human industry, electrical engineering came into existence at a time when the spirit of scientific enquiry had already become a dominant factor in shaping human progress. It is, like many another industry of recent date, the direct result of scientific research. Electrical engineering without a scientific foundation is an anomaly, an impossibility.

To an outsider, the marvellous growth of the new industry is somewhat difficult to realize. The time is not far back when dynamos were regarded with curiosity, and an arc light excited a feeling of wonder. The extraordinarily rapid development of electric lighting does not seem to have been brought home to the mind of the general public. Large central stations for electric lighting and power distribution are a growth so recent that we have not yet ceased being told that "electricity is in its infancy," a saying repeated so often that it is apt to excite a feeling somewhat akin to nausea. At this time of day, indeed, when millions of pounds are invested in costly electrical plant, it seems somewhat late to be made the recipient of this startling piece of information. Nevertheless, the saying has a moral of its own; it indicates a development so rapid that the mind of the general public has been unable to keep pace with it. What was new some three or four years ago is pretty well matter of ancient history today.

In surveying the rapid growth of the electrical industry, it may be said that development has proceeded along certain well-defined lines, and that along many of these a very advanced state has been reached. Early in the century we had the discovery of the electric arc, which first rendered electric lighting a possibility. Then came the development of the dynamo, by means of which the production of currents on a commercial scale was rendered possible; and the introduction of the incandescent lamp solved the difficulty of "distributing" the electric light. For a time, however, the high hopes which had been entertained regarding electric lighting were doomed to disappointment. A large number of companies, formed somewhat prematurely, came to an untimely end, and a reaction set in. Meanwhile, those who were capable of seeing somewhat more clearly than the promoters of ill-starred companies did not despair of the problem they had taken in hand. During the years of comparative inactivity which intervened between the first spasmodic efforts to introduce the electric light as a general illuminant and the subsequent successful solution of the problem, the dynamo received such careful study and attention as transformed it from a somewhat crude optician's toy into a substantial engineering structure perfect in every detail, and possessed of an efficiency which few other machines could boast. The calamities which overtook the earlier companies cannot, therefore, be looked upon as having produced wholly undesirable results. They prevented the introduction of machinery which eventually would only have retarded the progress of electrical engineering.

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CONTENTS.

PHASE.

The thorough comprehension of the meaning of the word "phase" has been attended with considerable difficulty by students engaged in electrical engineering. It seems that two views may be taken which appeal respectively to the theoretically inclined and practical mind.

The mathematical and physical interpretation of the term invites certain attitudes on the part of the student endeavoring to enlist his sympathies and exercise his power of mental absorption in both directions at once.

It becomes necessary to appreciate the full physical meaning of a phenomenon which, although peculiarly involved with the flow of electrical energy through a circuit, is in certain respects of a common and familiar nature.

There are many occasions when a perceptible period of rest occurs between an active cause and its effects—the lightning flash and the subsequent silence until the deep reverberation and boom of atmospheric tidal waves are heard re-echoed with deafening intensity.

And in the flow of a current, between its condition of fulness and moment of origin, an interval elapses. When an electromotive force is applied to create a flow through a given resistance, the maximum flow is not an instantaneous result of it, but a comparatively gradual growth takes place.

It is as though the wire suffered from a material incapacity to instantaneously convey the electrical energy at its maximum value onward.

It therefore becomes evident that if the retardation or *self-induction* were entirely absent, the current would attain its full strength the instant the electromotive force was applied.

The equation of Helmholz, which contains the key to the situation,

$$C = \frac{E}{R}\left(1 - e - \frac{R}{L}t\right),$$

likewise involves the factors of self-induction and time, whose influence upon a circuit are so aptly pictured by this formula.

Phase is therefore a term signifying time whatever may be its cause, and its existence is due to the lack of immediate correspondence between an electromotive force and the current it excites in a given resistance.

If a circuit has no self-induction and no electrostatic capacity, the maximum value of the current would be produced at once.

Whatever symbolic references may be made to the meaning of phase, and in whatever relation it may be held to other phenomena, let it be always understood as a purely physical phenomenon at the first, and then let the student with this clear conception in his mind proceed to invade that other world of relationships, that wide-stretching panorama of exactitudes and sine functions.

DIRECT-CONNECTED MACHINERY.

The growth of direct-connected plants is the first indication of a change that is about to sweep away many of the prejudices of antiquity.

Belt-driven machinery represented the first and simplest method of transmitting power from adjacent points. It became popular at a time when it was unwise to even experiment in other directions, because of the poor design of both engine and dynamo, the awkward and at times grotesque appliances used for the evident purpose of preserving uniform speed in the engine and the knock-kneed regulation of the dynamo. It was natural that engineers fought shy of even the suggestion of direct-connected plant, even though we may set aside the fact that they had troubles enough with their belt-driven plants at that period. But this antagonism to innovations wore off when the valve gear became improved, and it was not prejudicial to a man's career to believe that closely regulating engines were realities, especially when he had the proofs always behind him.

Then were the changes that may truly be said to have, Phœnix-like, raised the dynamo from the flames, it being common tradition today that the first Edison dynamos were supplied with a water-pipe circulating system to keep them cool. Now that this first shell of crudity has been removed from both pieces of apparatus, there is no objection, in any case, to the direct connection of both. In fact, so far has this idea gained ground that when a source of power has been perfected mechanically and the device to which it is to be applied is likewise a member of the "smooth-running order," that the immediate application of one to the other is becoming a common practice. In the machine shop we find this idea prevailing in the direct connection of motors to tools—in the absolute reliability of the machine shop superintendent upon these innovations of today by the entire removal of belts.

Losses in power represent ten times the amount used. In the electric-light plant this positive relationship between engine and dynamo is a feature that will always be present.

On board ships the direct-connected plant is at present the usual sight, as it will in the course of time be upon land. The use of direct-connected machinery has become so general that we doubt whether any new up-to-date machine shop would hesitate in the installation of motor-driven machinery. The number of shops of this kind is daily increasing, with a satisfaction and saving to the owners that they will readily admit.

THE TELEGRAPH.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The art of transmitting signals is of recent growth, but the history of earlier attempts dates back to at least a century ago.

When the fact became known that bodies naturally arranged themselves into two general classes—conductors and non-conductors—it was deemed probable that the transmission of signals electrically to distant points was a possibility.

At present the Western Union Telegraph Company possesses 600,000 miles of wire and sends annually about 50,000,000 messages.

This is the result of one man's work, in certain respects, who was impressed with the importance of a telegraph system, and through whose earnest efforts we are able today to sit in our homes and send messages thousands of miles away with inconceivable quickness and dispatch. Mr. S. F. B. Morse is the man whose name will be almost a synonym for the telegraph as long as it exists.

The labors of Henry in practically inventing the electro-magnet made Morse's work a simpler matter than had been expected. It is even believed and substantiated by considerable proof that an electric telegraph was invented by him, consisting of an electric bell actuated by a key, and in all respects of practical value. This was in the year 1831. But it seems to the reflective mind that perhaps the greater discovery of all was the invention of the electro-magnet, irrespective of its innumerable applications. It is in all reality the breath of life to electrical mechanism, such as motors, all signalling devices and a host of other important pieces of laboratory apparatus.

We can look back to a period prior to either Morse or Henry's and meet with Oersted, whose notice of the reaction between a compass needle and a current-carrying coil sent a wave of discussion through the scientific world.

Sturgeon subsequently built an electro-magnet whose core was of soft iron in place of the steel previously used.

Henry constructed a powerful electro-magnet capable of holding 2,000 pounds in suspense, which is in existence today.

The genius of Morse lay in the thorough appreciation of the value of a telegraphic instrument for direct use, the same in his time being practically an electro-magnet with a stylus or point cutting or marking the band of paper automatically fed beneath it, the point being actuated by an armature controlled by an electro-magnet and a key at some distant point.

The telegraph systems of today are about reducible to one—the Morse system.

Wheatstone, of England, and others produced printing and needle telegraphs, but none other than the printing telegraph besides the Morse has survived. The Morse outfit in its simple form consists of

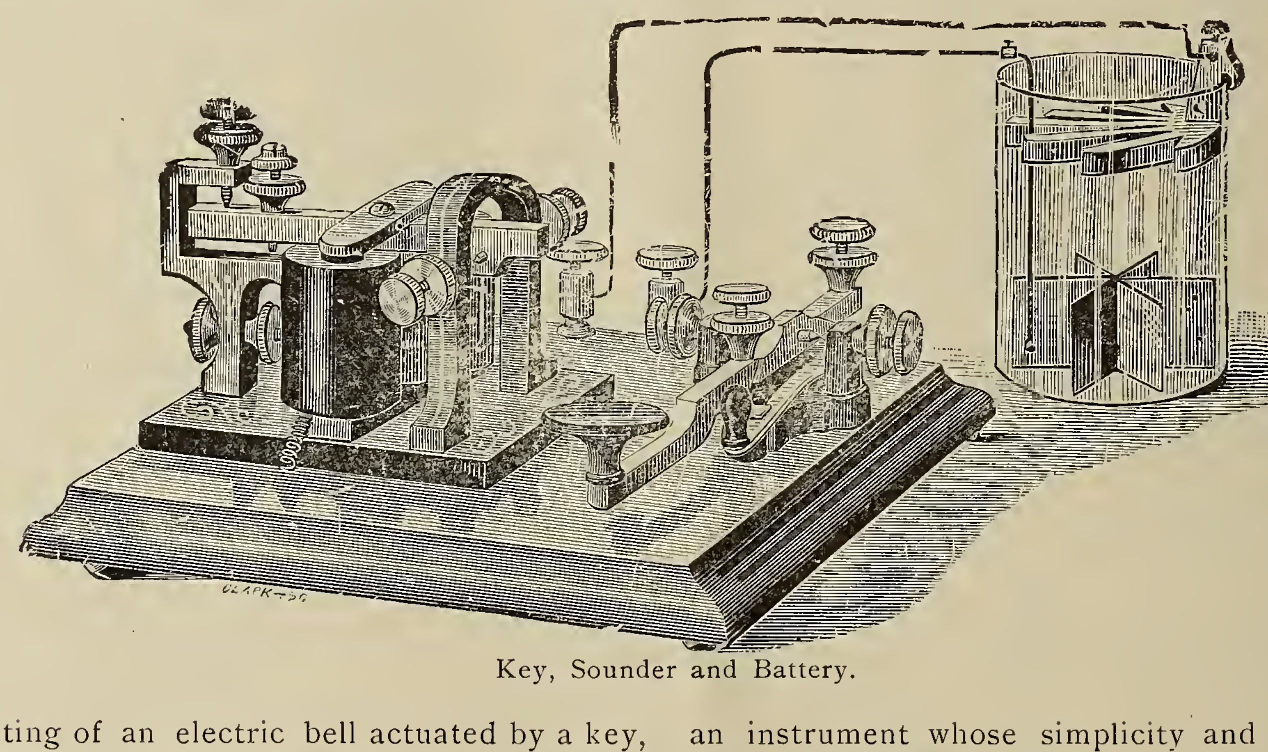
Key,
Sounder,
Line,

and a set of cells to operate the same.

The Key consists of a simple switch, the part pressed by the hand making contact with a point below, but springing back when pressure is released. The spring or lever portion connects with one wire and the point below with the other wire of the circuit.

The Sounder—whose original form was that of an electro-magnet which moved an armature, connected to which by an arm was a marking or cutting point making a series of dashes upon a paper strip—has been replaced by the original electro-magnet and lever with armature at the end. It was eventually noticed that the click of the older form of apparatus was capable of imparting a signal as well as the mark. Telegraphers became so experienced that the audible click was all they required to frame their sentences. The tape was then dispensed with for long-distance work, leaving the modern sounder in its place.

The great value of Morse lay in his ability at that period of comparative ignorance to place before the public an instrument whose simplicity and essential elements were so complete that today they are as great requirements as before.



Key, Sounder and Battery.

The Line was supported then, as now, upon poles with insulators. The first line connected with Washington and was only erected after a donation from Congress had been received. Its success was heralded all over the world as the results of an invention that at once elevated mankind immeasurably above the plane of life he had been living for untold ages.

Since Morse constructed the first simple, single-message telegraph, other inventors have improved upon it by the addition of mechanism for sending two, four or more messages over the single connecting wire at the same time.

A two-message system is called a duplex, if coming from opposite ends; from the same end, a diplex message. A double diplex or duplex constitutes the quadruplex. A system covering more than a single message at a time might justly be called a multiplex system, but is usually called such only when the number exceeds four at a time.

(Continued from Page 68.)

spare no expense in experimenting with the apparatus, and one of the first trials would be from Penarth to an island in the English Channel.

If the experiments were successful, it would be of inestimable value to shipping, for it would provide another easy way of communicating with lightships and lighthouses. To take an instance: Since last year they had had a cable with the Fastnet Light (the first light seen by Atlantic voyagers), but in the early part of this year it broke down, and they had never been able yet to land on the rock in order to repair it. But there was a possibility beyond this of enabling ships as they came near dangerous rocks and shallows to receive an intimation of the fact by means of these electric waves. Neither day nor night made any difference, fog or rain or snow would not interfere with them, and if the invention was what he believed it to be, our mariners would have been given a new sense and a new friend which would make navigation infinitely easier and safer than it now was.—Scientific American.

Light, Visible and Invisible, is stated by London Invention to have formed the subject of the usual Christmas course of lectures adapted to a juvenile audience, delivered by Professor Silvanus P. Thompson, at the Royal Institution. In his first lecture on December 29, 1896, the professor explained that light waves were very small, and travelled at a prodigious speed, which he explained by comparing them with the rate of travel of an express train. In the time the latter took to go 500 feet, if travelling at the rate of 60 miles an hour, sound would go one mile, while light would go a million miles. The behavior of waves towards obstacles, and the way in which they cast shadows were illustrated by experiments with ripples of water. The action of mirrors was also discussed, and it was shown how concave mirrors made the reflected rays converge while convex ones made them diverge. The action of lenses in making rays converge or diverge was explained to depend on the fact that light did not pass through glass at the same rate as through air, and that the rays being more retarded by the thick part of the lens came out with a hollow or a bulging wave front, as the case might be. Refraction in glass and water was then illustrated, and the quality of reflecting light from the upper surface commented upon. A beam of light was thrown upon a jet of running water and a piece of bent glass, which, in the darkened room, became luminous for a considerable distance, owing to the reflection from the inner surface, while no beam of light traversed the theatre itself. The Japanese magic mirror was then shown, reproducing from its polished surface in the reflected light the pattern on the back. The lecturer explained that the mirrors, made of bronze, had certain crests and images in relief on the back. When the polished front is being made, scraped with iron and severely scoured, the thicker parts offered more resistance than the thinner, and the result was a delicate hollow tracing of the back on the polished surface.

Jungfrau Mountain Railway.—One of the boldest schemes now proposed is an electric railway to the top of the Jungfrau peak in Switzerland. The peak is 13,670 feet above sea level. While heights approximating this have been attained in some of the mountains of the Andes and in the Rocky Mountain passes, no such grades as will be here employed have been attempted. A vivid idea of what the undertaking involves may be gathered from the fact that from the lower terminal at Scheldegg to the Jungfrau Peak, the difference in level is 7,000 feet, which rise will be accomplished in the total length of the road of only seven and a half miles. The road will alternately pass through tunnels and wind along the edge of mountains and glaciers, giving the passengers unique opportunities of gazing on superb landscapes. On the Monch mountain there will be a station, which, from its situation, will be of especial interest. It is in the centre of a circle of magnificent glaciers. From Monch the grade of the line descends to the Jungfrau Mountain, and then rises sharply to a point just beneath the summit. From this an electric elevator with a lift of 330 feet carries passengers to the peak itself. A remarkable feature of this and similar roads is that, whereas invalids were formerly cut off from the enjoyment incident to the ascent of famous peaks, even paralytics can now be taken to any altitude and can avail themselves of the succession of new and unexpected bits of Alpine scenery to which even pedestrians could not in many cases formerly gain. Electricity will not only be used for the propulsion of the cars, but for the lighting and heating, for the elevator, and even for the drilling and excavating of the six miles of tunnels, which have to be pushed often through the solid rock. The electric current will be derived from the waters of the Black and White Lutschine, a few miles distant. In winter these mountain roads are shut down on the higher levels, the main sections being retained for ordinary communal traffic. The traffic, in fact, corresponds with the season. When the snow line recedes up the mountain, the trolley cars climb after it, and as it extends down the sides of the peaks and valleys, the operation of the electric car is confined to the lower ranges. Several of the lines are controlled absolutely by the condition of the weather, due notice being given by telephone as to whether it is desirable for the cars to ascend to the upper parts of the system, and whether a view of the spectacular portions of the road can be secured by the passengers. It is said that a scheme is on foot to run an electric railway up Mont Blanc itself. Up to a certain altitude it would follow an inclined plane, and the ascent would be completed by a vertical shaft of a depth of 2,539 metres, through which powerful electric elevators would convey the passenger to the observatory on the summit.—Providence Journal.

Editor Electrical Age.

Dear Sir: -In the "Electrical Age" of January 9, 1897, Mr. Josiah Hampton asks, through the Inquiry Column, "Why telephonic speech is not possible completely around the world." According to the state of the art as it exists today I believe that it is possible, or, at least, the distance of telephonic communication can be greatly increased. The most formidable article to overcome for long distance work is self-induction. This can be fully eliminated by thoroughly insulating the conducting wire and then encasing it with a metallic sleeve, using the sleeve for a return current. The next best device would be to place two wires side by side, and as closely together as good insulation will permit. The insulation placed on one wire only; the other bare and occasionally connected to ground and used for the return part of the current. Iron wire, on account of its magnetic properties, can never be used for long distance work. The distance of telephonic speech would only then be limited by imperfect insulation. The ohmic resistance can be overcome by adapting the current to the requirements. It is generally believed to be impracticable to use a large battery for telephonic work; but, on the contrary, the current that can be used for telephonic transmission greatly exceeds that which is now used for the telegraph, which the telephone will supplant in the near future.

Respectfully,
A. G. Holcombe.

While investigating the properties of ozone, M. Otto was led to the conclusion that the luminosity produced when ozone and water are in contact is due to the presence in the water of organic matters of animal or vegetable origin. He is also of the opinion that most organic matters are capable of giving rise to the phenomena of phosphorescence, in the presence of ozone.—Comp. Rend.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—WINDING OF A TWELVE-INCH SPARK COIL.

Anaconda, Mont., Jan. 11, 1897.

Electrical Age, New York.

Gentlemen:—Will you kindly advise me, by mail, from what source I can secure information in detail on the winding of an induction coil giving *twelve* inch spark? Thanking you in advance and hoping I may sometime be able to reciprocate, I am,

Yours very truly,
W. B. Holmes.

(A.)—We have opened this Inquiry Column for the purpose of giving all the benefit of sensible questions and their answers, therefore we do not answer by mail.

There are two books which treat of the construction of coils.

Ruhmkorff Induction Coils, $0.50.
Induction Coils, - .50.

The sparking qualities of the secondary depend greatly upon the relation between the turns on the primary and secondary. A little experimenting with primaries of various turns will soon establish the best working conditions.

As an induction coil is merely a transformer, through the primary of which passes an interrupted current, the general formula might be kept in mind—

$$\frac{\text{turns on secondary}}{\text{turns on primary}} = \frac{\text{volts of secondary}}{\text{volts of primary.}}$$

(1) By building up the secondary in sections of separate coils, apart from each other, internal sparking is avoided.

(2) By having as few turns as possible on the primary self-induction is reduced.

(3) Good insulation between primary and secondary and in the secondary itself reduces leakage.

Further data rests upon an arbitrary basis and is greatly the result of personal experience. We hope to give detailed information with drawings on this subject in the near future.

(Q.)—POUNDS OF COAL PER HORSE POWER HOUR.

To the Editor of the Electrical Age:

Will you kindly advise me through the columns of your valuable paper what would be a first-class result; what would be a fair result, and what would be a poor result with reference to the rate of consumption of coal per horse-power per hour (giving the pounds of coal per horse-power per hour), under the following conditions, viz.: An electric light plant, using high-speed compound-condensing engines, the engines being two in number, each 225 h. p., the cards indicating 160 h. p. on each engine, the run being fourteen hours long, the boilers being water-tube, the steam 110, the vacuum 25 inches, and the coal being Packer pea of fair quality, and oblige,

A Subscriber.

(A.)—In our opinion the following would be about right:

First-class result	- - -	3 pounds.
Fair	" - - - - -	4 "
Poor	" - - -	5 "

An opinion kindly rendered by one of our friends, which we consider of value, is likewise appended:

Boilers might evaporate ten pounds of water per pound of coal. For long term charged with banking, etc., probably nearer eight. Engines at normal load would take seventeen or eighteen pounds of steam per h. p. hour; probably twenty with the underload mentioned. Two and a half or three pounds of coal per average h. p. would be good practice. The actual consumption would be greater than this, due to condensation, leakage, steam for auxiliaries, heating, etc.

(Specially contributed).

(Q.)—DOES A CURRENT KILL?

Atlanta, Jan. 3, 1897.

Editor of Electrial Age:

Dear Sir:—The common opinion at present prevailing is that criminals guilty of murder are executed at Auburn Prison by electricity. I consider it of consequence to many to know that an electric current itself does not kill, but the secondary reactions induced by its passage are the causes that exercise the deadly influence. If an antidote or at least instantaneous measure of relief were applied the patient would in many cases recover.

Truly yours,
Virgil Meeks, M. D.

(A.)—It is somewhat unfortunate that the causes of death are so separated from their inevitable effect. A current kills as effectually as a drug, or a wound, or a disease. Vitality is retarded and obliterated with a suddenness entirely dependent upon the extent of the cause. A fatal electric shock decomposes the blood, destroys the nervous system and causes an accumulation of blood in the head which results in so-called dynamic apoplexy. The cause in itself is not death, but its superinduced effects with a current are as fatal as with any other agency.

Thomas J. Fay & Associates, New York agents and general exporters for the Crocker-Wheeler Electric Co., 143 Liberty street, New York, have been awarded the contract for the ventilating motors to be used in Mr. John Jacob Astor's new hotel, comprising as folllows:

Two 24-H. P. motors, maximum speed 190 R. P. M.
One 30-H. P. motor, maximum speed 140 R. P. M.
One 32-H. P. motor, maximum speed 175 R. P. M.
One 40-H. P. motor, maximum speed 115 R. P. M.
One 60-H. P. motor, maximum speed 175 R. P. M.
One 90-H. P. motor, maximum speed 140 R. P. M.

These motors will be direct-connected to exhausters and blowers, and the plant is probably the largest and most complete electrical equipment for ventilating work for which a contract has ever been let.

NEW YORK ELECTRICAL SOCIETY.

The 179th meeting of the society was held at Columbia College on Thursday, January 14, at 8 p. m.

Mr. E. Leavenworth Elliott gave a paper on "Light: Its Distribution and Diffusion as Related to Quality and Efficiency."

The recent great advances in the economical production of gas and electricity have suggested in its turn the desirability of better means for the distribution and diffusion of the light when manufactured, an aspect of the light problem that has hitherto been to a great extent neglected.

Mr. Elliott's paper was directed to the discussion of the means for making the light-giving element most effective. It was illustrated with diagrams and apparatus bearing directly on the question.

The treasurer has notified me that for the convenience of members he will be glad to receive payment of dues at any meeting of the society. Yours truly,

George H. Guy, Secretary.

Water Power Phenomena.—Some interesting phenomena have been noted at the high fall water-power plant at Fresno, Cal., where the Pelton wheels are operated under a fall of 1,411 feet and an enormous pressure and jet velocity are developed. A sudden stoppage of the water flow will raise the hand of the pressure gauge to the astounding height of 1,000 pounds per square inch, the pressure returning eventually to nearly a corresponding distance below the normal, accompanied for over thirty seconds by a sharp reverberation. The great pipe writhes like a huge serpent, and the commotion in its interior sounds like the firing of distant cannon. The only safeguards in such sudden changes of flow are the great strength and elasticity of the steel. The water is applied to the Pelton wheels by deflecting nozzles. The terrific force that this stream of water is capable of is almost incredible. It will bore a hole through a three-inch plank in a few minutes; it will tear a hole through a three-eighths-inch piece of steel in a few days; concrete melts before it like sugar. The only successful mode yet known of safely stopping the motion of the water from the nozzle, is to put a heavy casting plate in the tail-race in such a manner that it can be quickly replaced when worn out.—National Recorder.

Some small cars propelled by motors driven by acetylene gas have lately been constructed in Italy. The charge consists of acetylene gas dissolved in fifteen times its volume of air, and with this mixture it has been found unnecessary to use water for cooling the cylinders. The method of igniting the charge has not, however, been made known. According to the Gastechniker, the motors maintain a speed of 600 revolutions throughout a working period of 15 hours. The weight is only about 20 pounds; and 0.8 brake horse-power is developed. The cost of working is said to be about 0.6d per hour.

The last decade has witnessed the establishment of central stations in all the more important towns throughout the United Kingdom. Something still remains to be done (in some towns, at any rate) towards rendering the supply pressure between the distributing mains somewhat more constant than it is at present. The price charged per supply unit will also probably be reduced when further advances have been made in dealing with the inconvenience caused by the peaky nature of the load curve. It is to be hoped that with a more general use of electric motors this latter difficulty will be to a large extent overcome.

Electric traction and the applications of electricity to chemical processes have up to the present not received in this country the full share of attention which they seem to merit, and during the next few years we shall probably witness considerable progress in these directions. The same remarks apply to power distribution by multiphase alternate-current motors.

It is easier to look back upon the past than to peer into the future. Yet one cannot but help looking forward to many important changes which future inventions and discoveries will work upon present-day practice. Looming large above all other problems is the one which is already engaging the attention of many able workers—the problem of "electricity direct from coal." It is probably rash to say that the day is not far distant when electrical energy will be got by the direct oxidization of carbon, and with an efficiency of conversion which will altogether outstrip all present-day indirect methods, in spite of all the sensational announcements of too-sanguine inventors and the jubilant articles singing their praises (somewhat prematurely) in popular monthlies. But although we have not yet learned how to do it; we have, at any rate, gained some knowledge as to how *not* to do it, and future workers will at least have some beacon lights to guard them in their arduous task. The quest is a difficult one, but the prize is high, and we can only hope that there will be found a Sir Galahad to whose enraptured gaze will be revealed the secret of what, when found, will undoubtedly prove one of the greatest achievements of modern science.—Electrical Engineer, of London.

NEW YORK LIGHTING CONTRACTS.

Contracts for lighting New York City during 1897 have been let. The number of lights furnished by each company and the price per light for each gas lamp are as follows:—

Equitable, 4,045, $12; Standard Gas Light Company, 2,215, $13.04½; Consolidated Gas Company, 14,107, $17.50; Central Gas Company, 1,460, $24; Northern Gas Company, 2,667, $28; Yonkers Gas Light Company, 799, $28; New York and New Jersey Company, 808, $22; 128, $21.50, and the Welsbach Company, 47 double lights, $47; 30 single, $30.

The electric light contracts as awarded were, per night: Brush Company, 710, 40 cents 92, 45 cents; Mount Morris Company, 361, 40 cents; Madison Square Company, 308, 40 cents; Manhattan Company, 241, 40 cents; Harlem Company, 209, 40 cents; Edison Company, 169, 50 cents, and the North River Company, 843, 45 cents.

The Edison Company's charge of 50 cents per night per light is for the new twin light used on Fifth avenue. —City Government.

The Gamewell Company has just sold 75 fire and 25 police alarm boxes to the city of Chicago. Chief Sweine, of the Chicago fire department, is a great admirer of the Gamewell alarm system and always recommends its use. —City Government.

Little Falls, N. Y.—The Little Falls Electric Light and Power Company and the Little Falls Gas Light Company have consolidated under the name of the United Gas and Electric Co., of Little Falls. Capital, $90,000; directors: Nelson R. Gilbert, William F. Lansing, Elijah Reed, Thomas Bailey and Watts T. Loomis, all of Little Falls.

Albany, N. Y.—The Auburn and Western Railway Company has been incorporated, to operate a street surface electric road, eleven miles long, from Auburn to the village of Seneca Falls. Capital, $300,000; directors: Robert Wetherill, of Chester, Pa.; William C. Gray, Jr., and Norman H. Becker, of Seneca Falls; George B. Longstreet, of Auburn; George B. Leonard, William P. Goodelle, W. A. Holden, Hiram W. Plumb and C. D. Beebe, of Syracuse. The company's principal office will be in Auburn.

St. Louis, Mo.—It has been decided by the St. Louis and Suburban Railway Co. to extend its electric line to Kirkwood, in the suburbs. Address, J. B. Case, vice-president of the company.

Depew, N. Y.—It has been learned that the Niagara Power and Conduit Company will soon connect this city with the Falls. They hope to get the patronage of such manufacturing concerns as the Central Locomotive Works, the Union Car Company, the Gould Coupler Company, Rood's Malleable Iron Works, the Brass Company and the National Car Wheel Works.

Cherry Creek, N. Y.—Cherry Creek is to have electric lights.

Houston, Tex.—The city proposes to erect an electric light plant for the purpose of lighting streets and public buildings. Address B. R. Warner, city secretary.

Winston, N. C.—Work will be shortly commenced on the erection of the proposed electric light plant. Address J. B. Temple, mayor, for information.

THE "VIM" BATTERY.

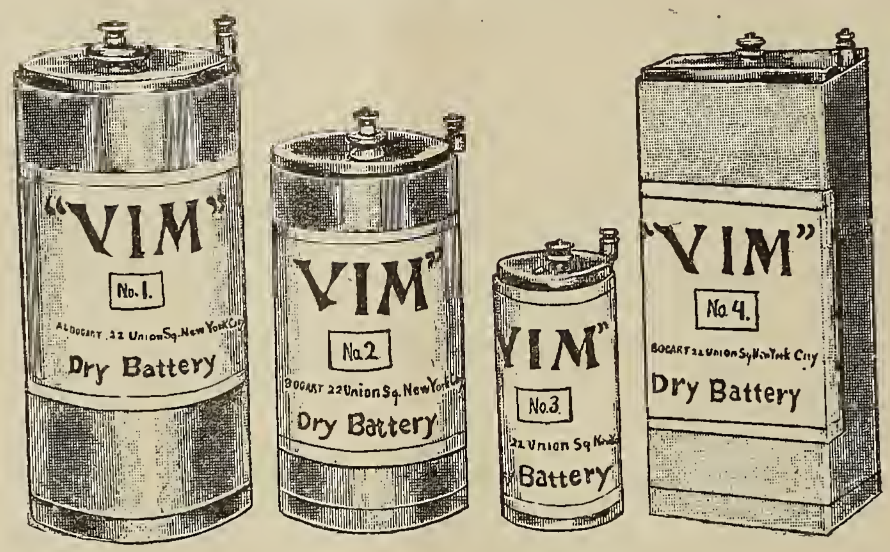
An excellent dry cell is being sold by A. L. Bogart, of 22 Union Square, N. Y. Its reliability and steadiness of discharge make it a superior cell for operating electric bells, burglar and fire alarms, telephones. annunciators, door openers, railway signals, medical apparatus, electric gas lighting, incandescent lamps, gas engines, Ruhmkorff coils and small motors. It is made in four sizes: No. 1, for spark coils, small motors and heavy work; No. 2, for ordinary bell work, etc.; No. 3, or midget, for bicycle bells, and No. 4, called the "Square," for clocks, or in cases where space is an object.

The following data may assist customers in selecting:

	Size.	Amperes.	Volts.
No. 1 - - -	7¼ x 3	8 to 10	1.5
No. 2 - - -	6 x 2¾	6 to 8	1.5
No. 3 - - -	4½ x 1¾	3 to 4	1.5
No. 4 - - -	6½ x 2¾ x 2	6 to 8	1.5

The above cell has a long life and will recuperate rapidly after heavy discharge. Being devoid of local action its excellence in this respect makes it unusually acceptable to the trade.

Made in Four Sizes.



AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 111th meeting of the institute was held at 12 West 31st street, January 20, at which President Duncan presided. Seventy-five members and guests were present. The topic for the evening was "Electrically Driven Vehicles," the discussion being opened by Mr. A. L. Riker and participated in by Messrs. Duncan, Reckenzaun, Coho, Corson, Adams, Duryea, Sachs, Van Hoevenbergh and Pope.

At the meeting of the Executive Members in the afternoon the following Associate Members were elected: Putnam A. Bates, student, Columbia University; residence, 113 West 72d street, N. Y. City. John Louis Hermessen, chief of data department, Union Elektricitaets-Gesellschaft, Kleist Strasse, Berlin, Germany. Ludwig Hommel, superintendent of construction, Standard Underground Cable Co., Westinghouse Building, Pittsburg, Pa. Wm. R. Kenan, Jr., chemist and electrical engineer, Australian Carbide Co., Sydney, N. S. W. Willard H. MacGregor, draughtsman, 359 West 27th street, New York City. Calvin Winsor Rice, consulting electrical engineer, 8 Eaton street, Winchester, Mass. (Entrance fee paid). Francis Arthur Rich, consulting mining and electrical engineer, Auckland, New Zealand. D. Franklin Stakes, electrical expert, The Fort Wayne Electric Corporation; residence, 240 West Washington street, Fort Wayne, Ind. Samuel G. F. Townsend, electrical engineer in testing department, with Ward Leonard Electric Co., Hoboken, N. J.; residence 131 Fifth avenue, N. Y. City.

The American Electric Meter Co., of the Betz Building, Philadelphia, have undertaken to supply the stations of this and other large cities with a reliable and comparatively inexpensive meter. The customers' bills have frequently been the cause of litigation to electric light and power companies. The power absorbed in the course of a year by meters that require too much energy is another source of loss.

The American electric meter requires to operate its pendulum about four-tenths of a watt for a twenty-two light meter; 1,865 of these meters only require in total one horse-power to run them. Each meter costs about 13 cents per annum to run.

The meter is supplied hermetically sealed. One screw on top of the box, a little care to see that the plumb bob is straight, and the meter is up.

The meter does not need recalibration after being installed. About once a year it may be overhauled, although this is not absolutely necessary. The meter consists in the 3-wire system of two solenoids and cores placed above a self-starting pendulum actuated by the electric current. The pendulum, by means of a cam, raises a pawl on a ratchet wheel to a uniform height each stroke. The solenoids, by means of their cores, shift the angular position of a pendent arch attached to their axis so as to permit this pawl to drop along the ratchet wheel a number of teeth proportional to the current passing through the meter; thus at each stroke of the pendulum the load in amperes passing to the consumer is, by means of the ratchet wheel and the dial register, measured and added up in ampere hours. That is all there is of the meter save a pointer and scale showing through the glass the amperes passing. The interior mechanism is supported by a brass frame, similar to that of a Yankee clock, and the case is cast iron, thus acting as a magnetic shield and preventing tampering with the meter by means of magnets on the outside.

The accuracy of this instrument is such that it could be used for the closest measurements. The absence of permanent magnets, etc., makes it an invaluable meter to the station and trustworthy in every emergency.

POSSIBLE CONTRACTS.

Brooklyn, N. Y.—It is reported that the building at Bay Shore, used as a clam factory by Henry L. Brown, has been purchased by the stock company, which will manage the lighting of Bay Shore streets. The electric light plant will be located in this building.

Woodstock, Va.—Address L. W. Brown regarding the erection of an electric light plant, which is being talked of.

Albany, N. Y.—The Southwestern Telegraph and Telephoue Company has certified to the secretary of state of an increase of capital from $3,000,000 to $4,000,000.

WARD ELECTRIC SUPPLY AND CONSTRUCTION COMPANY.

A strong combination of interests that speaks well for the electrical trade and also for buyers has been incorporated under the name of the Ward Electric Supply and Construction Company, 39-41 Ann street, New York City. The firm is comprised of Mr. O. B. Greene, formerly of No. 14 Cortlandt street, New York City, who carried on an extensive business in arc lamps of all kinds; Messrs. Deronda Levy & Co., of 39 Ann street, who have established a large construction and supply business, and Messrs. Greene & Dikeman, a firm popular in the electric light line. The parties named combined forces on the first of December as contractors and dealers in Ward and Knight arc lamps for low tension circuits, imported and domestic carbons and supplies. Mr. O. B. Greene was elected president; Chas. O'Keefe, vice-president, and Deronda Levy, secretary and general manager. This enterprising and energetic company are making themselves a necessity to the mauufacturers of electrical supplies, and there is a general demand for their services for the installation of arc lamps for incandescent lighting, photo-engraving, theatrical effects, motors for power work and general electrical construction of all kinds. They carry in stock a large supply of lamps and supplies, thereby being enabled to fill all orders with promptness and dispatch.

We compliment Mr. Deronda Levy upon his rapid progress, and feel sure that this consolidation of interests will be productive of one of the most substantial concerns we have.

ALEXANDER-CHAMBERLAIN ELECTRIC CO.

The Siegel-Cooper plant, designed and installed by the Alexander-Chamberlain Electric Co., 52 West 22d street, besides being the largest installation of its kind in the world, practically demonstrates the use of electricity for light, heat, power, ventilation and cooking on a larger scale than heretofore attempted. The construction of this plant and its details, many of which are novel, were admirably carried out.

Great credit is due the firm for its excellent work in installing and successfully completing the vast contract they had undertaken according to time and specifications.

NOTICE.

C. C. Sibley & Co.—Notice is hereby given that the partnership lately subsisting between Clarence C. Sibley and T. M. Randolph Meikleham, under the firm name of C. C. Sibley & Co., was dissolved on the first day of January, 1897, by mutual consent. The business of said firm will be continued by said T. M. Randolph Meikleham at No. 329 Fourth avenue, New York City, and all debts owing to the said partnership are to be received by him, and all demands on said partnership presented to him for payment, and he is authorized to settle all debts due to and by said firm.

Dated New York, January 1, 1897.

(Signed)

Clarence C. Sibley.
T. M. Randolph Meikleham.

SUCCESSOR.

I beg to inform you that the partnership lately existing between Clarence C. Sibley and myself, under the firm name of C. C. Sibley & Co., was dissolved on the first of January, 1897, by my purchasing the interest of Mr. Sibley.

I propose to continue the business of the said firm at No. 329 Fourth avenue, New York City, under my name as successor to C. C. Sibley & Co., and am authorized to receive and give proper receipt for all debts owing to the said partnership.

Trusting that you will kindly continue to favor me with your patronage, I beg to remain,

Yours respectfully,
T. M. R. Meikleham.

REMOVAL NOTICE.

Owing to increase of business the Phœnix Interior Telephone Company have been obliged to remove to larger quarters, and have leased the fine, light, five-story building at 93 Washington street. They will occupy the same on and after January 14, 1897. The first floor will be devoted to the officers of the company, the second and third to machinery, and the top floor to the process o assembling. The Phœnix Interior Telephone Compan have been steadily progressing in their particular line of work and have earned a great reputation amongst the trade for the excellence of both their goods and methods

THE TRADESMAN 18TH ANNUAL.

The 18th annual number of The Tradesman, published at Chattanooga, Tenn., contains over 260 pages, and presents the most complete, exhaustive and valuable review of the South, its resources, development and possibilities, that to our knowledge has ever been published. The special articles are from the leading thinkers, statisticians and business men in our country; the information given is the result of careful investigation and practical knowledge. The business directories and statistics are most valuable features of this valuable number and it will be preserved as a reference book on all subjects pertaining to the South and its resources. Among its contributors are six southern governors, the chief statistician of the United States census bureau, twelve leading southern journalists, twenty leading southern chamber of commerce officials, such writers as Edward Atkinson and a score or more of statistical writers and industrial authorities in their special lines, whose reputation is national and international. Of the many features is a complete directory of 5,000 of the leading industrial plants of the southern states.

CITY GOVERNMENT.

As a well written, up-to-date and interesting sheet we recommend "City Government" to our readers.

It covers a field that has long lain neglected, but which in this new periodical receives the proper and correct attention.

It is a valuable paper to the city official, because, as its sub-title informs us, it is "devoted to the practical affairs of municipalities." Mr. Clarence E. Stump, the president and treasurer, has devoted himself to this paper, and with the assistance of B. F. Gilkison, the vice-president and secretary, will make City Government a pronounced success.

CALENDARS.

Some of our friends have been kind enough to send us handsome souvenirs that have frequently prevented us from getting our dates mixed. We tender our thanks to them for this great service.

The following concerns honored us by sending pretty calendars to the "Electrical Age:"

Puritan Electric Co., manufacturers of noiseless enclosed arc lamps for alternating and constant potential circuits, 150 Nassau street, N. Y.

Commercial Cable Co., whose enterprise has built up the practice of sending transatlantic communications with the readiness of a land message.

Shultz Belting Co., whose ability to compete has taken strange hide off many a concern.

Cutter Electric & Manufacturing Co., of the automatic magnetic circuit-breaker fame—a calendar of choice and artistic excellence.

The Connecticut Telephone & Electric Co., of Meriden, Conn., manufacturers of telephones, supplies and entire equipments, of whom we received a calendar that has been clothed in gauze. All our friends would feel likewise that saw one.

H. B. Coles & Co., electrical engineers for electric light, heat and power machinery.

Indianapolis, Ind., January 14, 1897.

The Electrical Age Pub. Co.

Gentlemen:—Having on the 19th of December retired from the firm of MacCurdy & Smith, I have opened an office in the Baldwin Block, this city, as manufacturers' agent and cousulting electrician. I have already closed contracts for a number of first-class agencies and have negotiations pending for a number more.

I intend working this state and parts of Illinois, Ohio, Michigan and Kentucky, and have every prospect for an excellent business in the near future. Trusting that this item may be of interest to you, I am,

Very truly yours,

Wm. C. MacCurdy,

Manufacturers' Agent, Expert Electrical Engineer,
Room 42, Baldwin Block.

TELEPHONE NOTES.

Camden, N. J.—The ordinance granting a franchise to the Camden Telephone Company has every prospect of passing city council. As more than 300 subscribers have made contracts for the new service it will, no doubt, receive favorable consideration. No tangible objection has been raised against the enterprise, in which a number of well-known business men are interested, and as it assures excellent service at reduced rates it has popular approval.

Lockport, N. Y.—At a meeting of the common council held on January 18, the Bell Telephone Company of Buffalo was granted a franchise to operate in this city for the next fifteen years. Under the new franchise the company must furnish the city with six telephones free, erect poles and make all needed repairs to the fire alarm system within twenty days, furnish a $15,000 bond and be prepared to place all of their wires and those of the fire alarm system in underground conduits any time the council may designate. The franchise was granted over the veto of Mayor Peterson. The franchise granted to the Citizens' Mutual Telephone Company a year ago was modified, leaving the two companies open to competition.

NEW CORPORATIONS.

Philadelphia, Pa.—Notice is hereby given that an application will be made to the Governor of the State of Pennsylvania on Monday, February 8, A. D., 1897, by Cornelius J. Carney, Eugene T. Clark, Thomas A. Carney, Claude B. Early and James C. Doyle for the charter of an intended corporation, to be called The Southwark Merchants' Electric Light and Power Company, the charter and object of which is to supply light and power by electricity to the public in the county of Philadelphia. Suddard, McInnes & O'Donovan, solicitors.

The annual meeting for the election of directors by the stockholders of the corporation of L. J. Wing & Co., was held at the office of the company, 245 Washington street, Jersey City, N. J., from 2 to 3 P. M., on January 21, 1897. Mr. L. J. Wing was re-elected president; Mr. Silas P. Wheeler, vice-president, and Mr. G. A. Wing, secretary and treasurer.

ELECTRIC STOCK QUOTATIONS.

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	35	38
Edison Illg. Co (St. Louis),	10	17
Eddy Electric Mfg. Company,	—	19
*Edison Elec. Illg. Co., New York,	104	105
Edison Elec. Illg. Co., Brooklyn,	98	100
Edison Ore Milling Co.,	7	10
Edison Elec. Storage Company,	28	29
Fort Wayne Electric Company,	3	3½
Ft. Wayne Elec. Co. T. Sec. Series A,	3	4
General Electric Company,	34¾	35¼
General Electric Company pf.,	77½	79
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	81½	82
Rhode Island Elec. Protec. Co.,	110	122
Toronto (Canada) Elec. Light Co.,	125	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4¼
Thomson-Houston Welding Co.,	5	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse El. & Mfg. Co., pf.,	50	51
Westinghouse El. & Mfg. Co., assd.,	23¾	24½

*Ex dividend.

The Electrical Age.

VOL. XIX., No. 6. NEW YORK, FEBRUARY 6, 1897. WHOLE No. 508

Two 20 H.-P. Induction Motors in the Threading and Finishing Shop.

POWER TRANSMISSION TO NORTH TONAWANDA.

Although the transmission of power outside the limits of Niagara Falls is not yet a month old, a large nut and bolt works at North Tonawanda has been waiting, fully equipped for the appearance of the current, for the past year. These works, the largest nut and bolt factory in the country, are those of Messrs. Plumb, Burdict & Bernard.

At the time the electrical equipment was under consideration, the question of utilizing Niagara power naturally arose, and it speaks volumes for the foresight both of the owners of the works and the equipping company, the General Electric Co., that the three-phase system was selected, instead of the two-phase. The three-phase system having been chosen by the Niagara Falls Power Co. for the transmission of power from Niagara Falls to Tonawanda and Buffalo, the bolt and nut works can be operated directly from the transmission line by simply connecting the necessary static transformers.

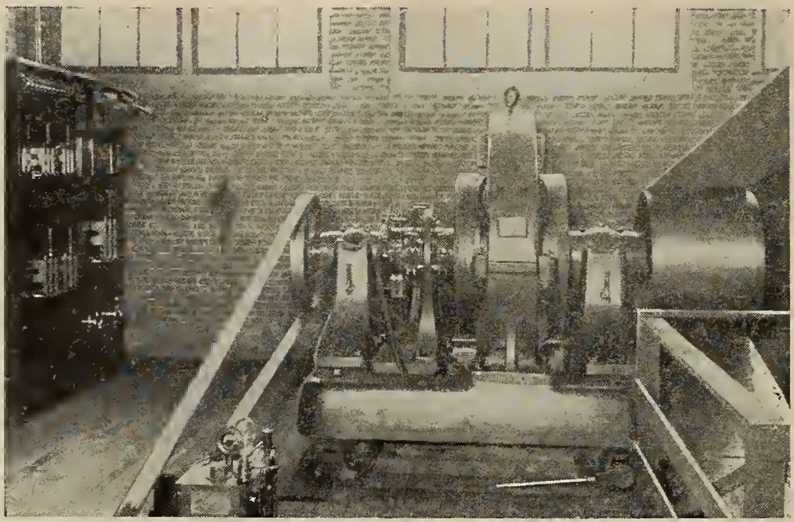
The factory of Messrs. Plumb, Burdict & Bernard is situated at North Tonawanda, directly on the lines of the New York Central and Erie Railroads, and about half a mile from the route taken by the overhead wires of the Niagara Buffalo transmission. It is divided into three single-story brick shops, running north and south, the forge being nearest the railroad; the cold shop, engine room and machine shop lying in the centre, and the threading and finishing shops on the side nearest the transmission line. All the work, with the exception of the cold work, starts at the forge shop and passes on through the various operations until it leaves the finishing shop ready for the market. There is no waste of labor and time passing material from different points in the shops. The progress is methodical, each succeeding operation being set next to the previous one.

Until Niagara power can be obtained, the works are being operated from their own generating station, which will be abandoned as soon as the Niagara Power Company is ready to tap the three-phase lines into the factory. The generating station is set between the cold and machine shops in the central building. Steam from the engine is supplied by three Riter Brothers return tubular boilers, each of 100-H. P. capacity. The engine is an improved Green of 400-H. P., belted to a General Electric Co. three-phase, six-pole, 150-K. W., 25-cycle, 500-R. P. H. generator. The exciter is a 3-K. W., 125-volt bipolar machine. The switchboard is of panel type, built up of two panels, one for the generator, the other for the feeders. The generator panel carries potential indicator, two current indicators, field-switch, main switch, and two Carpenter enamel rheostats. The feeder board in addition to the fuses is equipped with four three-blade knife-switches, each controlling one circuit and labelled "cold press," "machine shop," "thread shop," "forge shop," respectively.

The forge shop, where the nuts and bolts are cut off from the raw rods and bars, is about 360 feet long, having the forges and machines set down each side of a central aisle, along which a track is laid. Above the machines on each side runs a line of shafting, and in arranging the line of shafting Messrs. Plumb, Burdict & Bernard have adopted a very simple method. Suspended from the roof girders down each side are four lines of channel iron in two sets, each set bolted back to back. Each line is separated from the other about 20 inches. Through the space between each pair of channels pass long bolts which support the hangers for the shafting, and allow of a ready rearrangement at any time. This method is adopted throughout the shop.

The forge shop contains five 20-H. P. General Electric

induction motors, four driving the shafting and one operating a blower. The shafting is divided into four sections, and each one is belted to one of the induction motors.

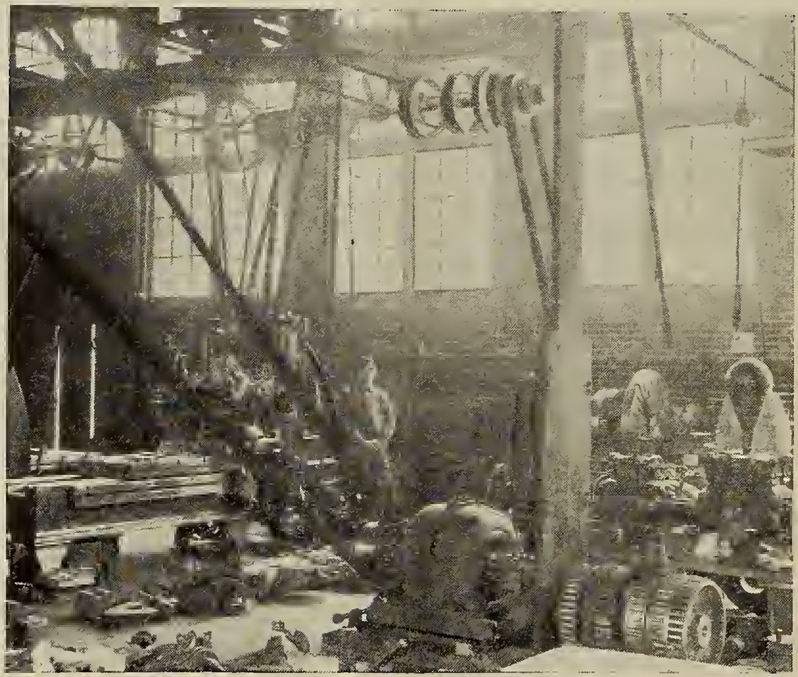


Three-phase Central Station.

The driving motors themselves are set upon a platform above the shafting in the centre of the shop, and are boxed in. The blower motor directly connected to the blower occupies a platform at the south end of the shop. The machinery driven by the motors in the forge shop are different sizes of bolt headers, and nut punchers, and shearing machines for shearing the bolt lengths from the rod.

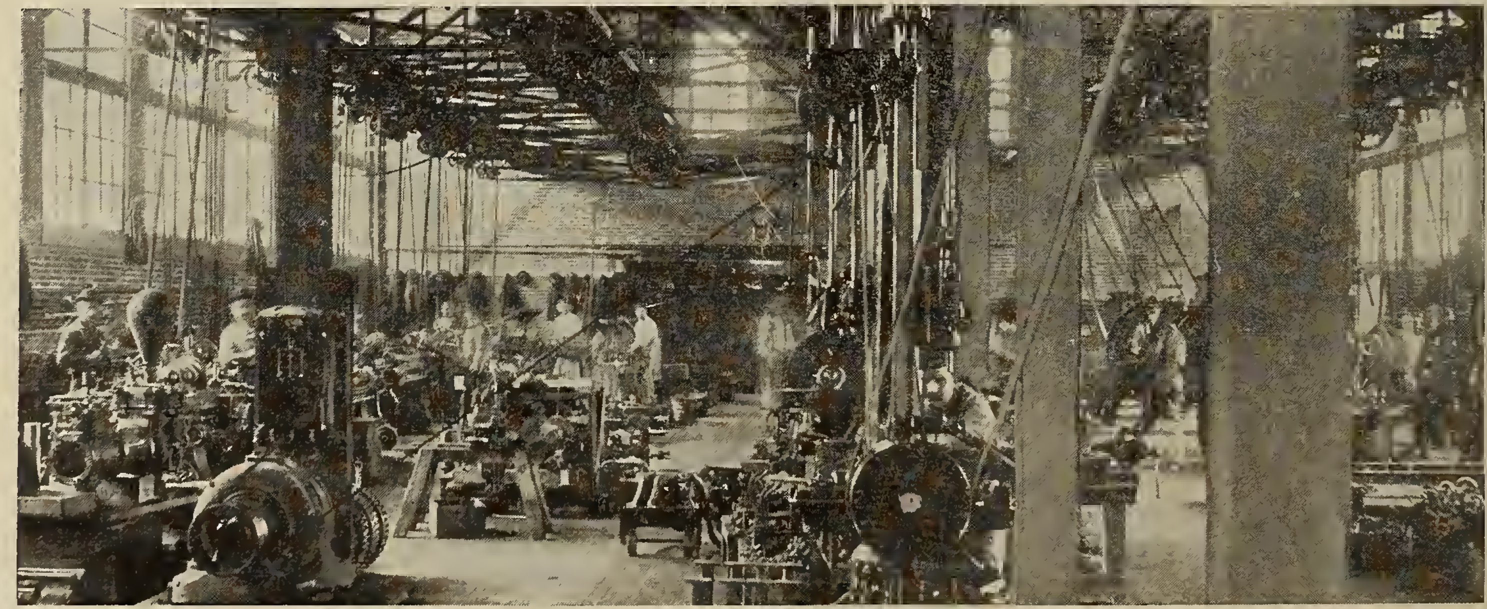
In the cold shop the pointing department is operated by one 20-H. P. motor, set on the floor and belted to jack-shafts and coutershafts as necessary.

In the machine shop, lying on the south side of the engine-room, is another 20-H.P. motor, also set upon the floor. It is used to drive a variety of tool-making machinery, such as planers, milling machines, drills, slotters, shapers, etc.



One Corner of the Machine Shop, Showing 20 H.-P. Induction Motor.

The threading and finishing shop, 400 feet long, is next in length to the cold shop, which is 430 feet in length. In it the bolts and nuts travelling from the other shops are threaded and tapped and put together ready for the market.



20 H.-P. Induction Motor Driving Tool Making and Other Machinery.

This threading and tapping of the smaller pieces is

effected automatically for some and semi-automatically for others, and in all cases the operations involve some of the prettiest automatc and semi-automatic work to delight the eye of the mechanic. The automatic nutters which put the nuts upon the bolts are more than human in their accuracy and speed.

This shop is driven by six 6-H. P. motors set on small platforms, and three 20-H.P. motors. The smaller motors and one 20-H. P. motor are used to drive the automatic and semi-automatic machines. For the former they are belted to jack-shafts, from which belts are dropped to pulleys on a shaft running underneath the machinery. For the semi-automatic machinery, the pulley is on the level of the machines and is belted to the jack-shaft above.

The other 20-H.P. motors are set on the floor and are belted to shafting on the opposite sides of the shop, as shown in the illustrations. These serve to drive the heavy threading and tapping work not automatic, and some idea of the variety of machinery in these shops, and the work the motors are called upon to do, may be gathered from the fact that the sizes of bolts made run from $\frac{3}{16}$-inch up to $1\frac{1}{2}$-inch.

The advantages of electric drive are markedly noticeable in this plant. There are no separate engines for the individual shops and no belt holes in the walls, as would have been the case had the steam driving plant been confined to an outside building. The wires come through three small porcelain bushed holes in the wall of each shop. The central steam and generating station is confined to one room at present, and will probably shortly be entirely abolished. The motors in the forge shop occupy no space on the floor of the shop, and those in the other shops occupy either small space upon the floor or are erected on small platforms. They require no attention beyond the filling of oil wells, which is performed but once in six months. They are started by the throwing of a switch, and maintain a steady and constant speed under all conditions of load. This is noticeable in the quality of the output.

ELECTRIC LIGHTING FOR JAPAN.

A Pittsburgh journal notes the fact that two important Japanese representatives were in that city recently, J. Kobori and S. Ishidi, of Yokohama. They were there to purchase an entire electric lighting outfit for the municipality of Yokohama. They spent the day at the Westinghouse works. Upon arriving there they found that the apparatus could not be purchased, but must be bought from the general office in New York. They left for that city.

During their visit to East Pittsburgh, the Japanese were taken through the shops. Both are mechanical engineers, and pronounced the works the most thoroughly equipped they had ever seen.

We must realize that the world is moving on, and that every year thousands of new plants are being installed and shops equipped with machinery arranged according to a new plan.

No man disbelieves more thoroughly in the continual waste of power than Tesla, and we find in the leading invention of the age—in the oscillator—a crystallization of this idea: a direct combination of engine and dynamo; a complete union between the source of energy and the device it is to exercise its power upon.

Hawkinsville, Ga.—As soon as plans can be prepared the city will arrange for the construction of its water and electric light plants. J. L. Ludlow, constructing and designing engineers.

THE DETERMINATION OF THE COST OF ELECTRIC LIGHTING BY GAS ENGINE.

BY MESSRS. J. L. CHRISTY, M.E., AND S. A. HASBROUCK, M.E., IN THE STEVENS INDICATOR.

1. Abstract of Thesis, submitted by authors before the Stevens Institute of Technology, June, 1896.

The plant consists of a 10-horse-power gas engine, of the "Otto" type, belted to a counter-shaft and thence to an "Excelsior" dynamo of the Churchward four-pole type. A counter-shaft was used so that a dynamometer could measure the power delivered to the dynamo.

Description of Engine.—The valves of the engine are both positive in action, being actuated by levers which receive their motion at the proper time, by means of cams. These cams are keyed to a shaft at right angles to the main shaft and receiving its motion by means of gears of the "worm and wheel" type.

The air is taken from the base of the engine, thus muffling the sucking noise; while the gas is governed by a small valve worked at the proper time by the governor.

The governor is of the "pendulum" type; its method of operating being such that if the speed of the engine is too great the "toe" of the governor is lifted, thus missing the gas valve and preventing an explosion until the engine has resumed its proper speed. The ignition is "hot tube." The exhaust is first expanded into a large iron pot and then passes into the air.

The dynamo is a four-pole compound wound machine with carbon brushes, which feed perpendicular to the surface of the commutator, thus insuring the constancy of the "neutral" point. The "mains" lead from the dynamo to the "bus-bars" of a marble switchboard, being controlled by a double knife-switch. From the "bus-bars," mains, controlled by a double knife-switch, lead to ten pull-switches, each controlling ten lights. The "lights" are banked on a swinging board in the window, and there is also a "pilot" light, across the brushes of the dynamo. Each of the two main circuits and of the ten small circuits is protected by fuses. A Weston ammeter is on circuit from the dynamo and a Weston voltmeter is across the "bus-bars." The shunt field of the dynamo is controlled by a rheostat on a switchboard.

Indicators.—The indicators are the new form Tabor, the spring, 207 pounds, as connected by a Crosby testing set. For a reducing motion a "Bromble" pulley was used.

The "explosion" recorder designed and built by the writers will be very easily understood by reference to the cut. It is simply an indicator, whose piston area is one-quarter of a square inch, to reduce the shock of the explosion which moves the figures or dials of a revolution counter instead of a pencil. The electrical instruments are the Weston standard, and were accurately standardized at the electrical laboratory of the institute.

The Tables.—The following tests contain the data taken at the engine; the averages for each test, and a table of comparison of costs at different loads:

Test I.

No. of Card.	Rev. of Engine.	Explosions.	Gas Meter.	Volts.	Amperes.	No. of Lights.	Revolutions. Dynamo.	Revolutions. Countershaft.
1	280	434,533	9,620	115	9.5	21	1,280	498
2	284	....	.....	112	9.1	21	1,300	510
3	280	....	.....	108	9.0	21	1,320	520
4	280	....	.....	110	9.5	21	1,355	508
5	280	....	.....	115	9.0	21	1,390	512
6	280	....	.....	112	9.0	21	1,336	510
7	276	....	.....	112	8.8	21	1,338	500
8	280	....	.....	109	8.5	21	1,324	520
9	272	....	.....	108	8.5	21	1,320	500
10	280	....	.....	107	9.0	21	1,320	500
11	272	....	.....	110	8.5	21	1,360	520
12	270	....	.....	108	8.8	21	1,300	500
13	264	....	.....	109	8.6	21	1.332	500
14	268	....	.....	109	8.5	21	1,294	498
15	268	....	.....	107	8.5	21	1,340	500
16	272	....	.....	107	8.4	21	1,298	490
17	264	450,619	10,163	106	8.8	21	1,260	490

Ignition tube requires 4 cubic feet of gas per hour.
Spring used, 207 lbs.
Bore of cylinder, 7 inches. Stroke, 13 inches.

TEST 1.—*Calculations.*

Revolutions per minute	274.7	
Explosions (total)	16,066.0	
" per minute	66.94	
Gas (total)	643.	feet.
" used by engine = 543 — 4×4	527.	"
" per hour 527 ÷ 4	131.75	"
" " indicated h. p.	22.6	"
Volts	109.6	
Amperes	8.8	
Watts = 109.6 × 8.8	964.48	
Electrical H. P. = $\frac{964.48}{746}$	1.29	
M.E.P.	68.79	
Initial pressure, average	249.4	lbs. abs.
" highest	366.6	"
" lowest	165.8	"

$$\text{I.H.P.} = \frac{13 \times 38.48 \times 66.94 \times 68.79}{12 \times 33{,}000} \quad 5.82 \text{ I.H.P.}$$

Cost per hour, gas costing \$1.25 per 1,000 cubic feet $\frac{131.75}{1{,}000} \times 1.25$ \$0.165

Cost per lamp hour $\frac{\$0.165}{21}$ 0.78

Test II.

The following set of readings were taken at intervals of 15 miuutes, from 8:45 A. M. to 11:45 A. M.:

No. of Card.	Rev. of Engine.	Explosions	Gas Meter	Volts.	Amperes.	No. of Lights.	Revolutions. Dynamo.	Revolutions. Countershaft.
1	256	382,660	11,561	108.0	36.0	81	....	....
2	240	384,470	....	106.0	35.5	..	....	....
3	248	386,170	....	106.0	35.5	..	....	....
4	248	....	....	106.0	35.5	..	....	....
5	254	....	....	107.0	37.0	.	....	....
6	254	....	....	108.0	37.5	..	....	....
7	254	....	....	108.0	37.5	..	....	....
8	256	....	....	110.0	38.0	..	....	...
9	254	....	....	108.0	37.0	..	....	....
10	264	....	....	112.0	39.0	..	....	....
11	264	....	....	111.0	38.5	..	....	....
12	268	....	....	110.0	38.0	..	....	....
13	268	12,146	....	112.0	38.5	..	....	....
Avg.	256	585	....	108.6	37.2	..	....	....

Remarks:

At 8.45 consumption	180.0	feet.
" 9.45 "	211.7	"
" 10.15 "	196.5	"
" 10.50 "	196.7	"
" 11.30 "	181.8	"
" 11.45 "	182.8	"

Calculations of Test II.

Revolutions per minute 256.

Explosions (total) $\frac{(256 - 4)}{2} \times 180$ 22,320.

" per minute 124.

Gas (total) 585.

" used by engine, 585 — 4 × 3 573.

" per hour $\frac{573}{3}$ 191.

" " per I.H.P. 18.51

Volts 108.6

Amperes 37.2

Watts—108.6 × 37.2 4,039.92

Electrical H.P. = $\frac{4{,}039.92}{746}$ 5.41

M.E.P.	65.91	lbs.
Initial pressure, average	277.53	lbs. abs.
" highest	314.85	"
" lowest	186.51	"

$$\text{I H.P.} = \frac{13 \times 38.48 \times 124 \times 65.91}{12 \times 33{,}000} \quad 10.32$$

Cost per hour at \$1.25 per 1,000 cubic feet, $\frac{191}{1{,}000} \times 1.25$ \$0.239

Cost per lamp per hour 0.29

Test III.

The following set of readings were taken at intervals of 15 minutes, from 5.10 P. M. to 7.10 P. M.:

No. of Card	Rev. of Engine.	Explosions.	Gas Meter.	Volts.	Amperes.	No. of Lights.	Revolutions. Dynamo.	Revolutions. Countershaft.
1	252.0	394,506	13,505	108.0	41.0	91	1,320.0	460.0
2	256.0	......	....	102.0	43.0	101	1,290.0	478.0
3	250.0	......	....	104.0	41.0	96	1,320.0	475.0
4	254.0	......	....	105.0	41.5	96	1,360.0	475.0
5	250.0	......	....	106.0	41.0	91	1,355.0	476.0
6	250.0	......	....	103.0	40.0	91	1,350.0	473.0
7	248.0	......	....	102.0	38.0	86	1,350.0	473.0
8	250.0	......	....	100.0	34.3	71	1,365.0	470.0
9	250.0	408,619	13,903	104.0	32.0	71	1,360.0	470.0
Avg.	251.1	14,113	398	103.7	39.5	88	1,341.1	472.2

Remarks—Fluctuation of 1.5 volts:

At 5.40 gas used	189.3	feet.
" 6.00 "	189.3	"
" 6.15 "	190.0	"
" 6.30 "	193.5	"
" 6.50 "	195.6	"

Calculations of Test III.

Revolutions per minute	251.1	
Explosions (total)	14,113.	
" per minute	117.6	
Gas (total)	398.	cu. feet.
" used by engine, 398—2 x 4	390.	"
" used per hour = $\frac{390}{2}$	195.	"
" used per hour per I. H. P.	20.28	"
Volts	103.7	
Amperes	39.5	
Watts	4,096.15	
Electrical H. P. = $\frac{4{,}096.15}{746}$	5.49	
M.E.P.	64.67	lbs.
Initial pressure, average	293.69	lbs. abs.
" " highest	308.64	"
" " lowest	283.80	"

$$\text{I.H.P.} = \frac{13 \times 38.48 \times 117.6 \times 64.67}{12 \times 33{,}000} \quad 9.61$$

Cost per hour at \$1.25 per 1,000 feet $\frac{195}{1{,}000} \times 1.25$ \$0.244

Cost per lamp per hour $\frac{.244}{88}$ 0.277

Prony Brake Test.

Time P.M.	No. of Card.	Rev. of Engine.	Explosions.	Gas.	Weight on Scales.
1.25	1	260	388,881	13,170	250 lbs.
1.30	2	272	.....	....	256
1.35	3	256	.....	....	250

1.40	4	256	.....	....	300
1.45	5	256	.....	....	250
1.50	6	272	.....	....	300
1.55	7	264	.....	....	300
2.00	8	272	.....	....	300
2.05	9	264	.....	....	300
2.10	10	240	.....	....	300
2.15	11	264	.....	13,355	300
2.20	12	264	394,505	....	300
Average	..	258.3	5,624	185	283.8

Remarks: Initial weight on scales = 45 lbs.

Calculations of Prony Brake Test.

Revolutions per minute . . . 258.3
Explosions (total) . . . . 5,624.
" per minute 102.26
Gas (total) . . . . . . 185. cu. feet.
" used by engine, $185 - 4 \times \frac{55}{60}$ . . 181.34 "
" used per hour . . . . 197. "
" used per hour per I.H.P. . . 22.69 "
M.E.P. . . . . 67.19 lbs.
Initial pressure, average . . . 302.94 lbs. abs.
" " highest . . . 333.48 "
" " lowest . . . 281.73 "

$$\text{I. H. P.} = \frac{13 \times 38.48 \times 102.26 \times 67.19}{12 \times 33{,}000} \quad . \quad 8.68 \text{ "}$$

Prony Brake H. P.

Diameter of pulley . . . . . . 16″
Circumference of pulley . . . 4.188′
Weight on scales, average . . . 283.83 lbs.
" " initial . . . 45. "
" " final . . . 238.83 "

$$\text{P. B. H. P} = \frac{4.188 \times 258.3 \times 238.83}{33{,}000} \quad . \quad 7.8$$

From the foregoing data it will be seen that for private houses, summer hotels and other isolated plants a gas engine is a very convenient and economical source of power for electric lighting. To obtain a light of 16-candle-power, by burning the gas in the usual way, requires 5 cubic feet of gas per hour. Taking the cost of the gas at $1.25 per 1,000 feet, a 16-candle-power light would cost 0.625 cent per hour. Under a very light load the plant is more costly than by burning the gas directly; but as the load increases the cost diminishes, so that at full load it is far cheaper, in this plant, to use the gas in an engine to generate the electric light than to burn the gas for light.

By using producer gas, which can be furnished at 75 cents per 1,000 cubic feet, the cost is correspondingly reduced. At that rate, in Test II., instead of the cost of a lamp hour being .29 cent, it would be .17 cent.

There are a few small expenses for oil, waste, etc., that will somewhat increase the cost, but all conditions considered, the production of the light by a plant of this kind is more economical than the direct consumption of the gas in burners.

The Bertrand-Thiel Steel Making Process.—A paper on this subject, to which we hope to refer more fully in our next issue, was read before the Cleveland Institute of Engineers, on December 14, by Mr. Percy C. Gilchrist. The process consists in doing in two furnaces, or two series of furnaces, what has hitherto been done in one furnace, and in employing a temperature sufficiently high to cause the metal flowing from the first series of furnaces to emit a copious vapor which, when seen, is reddish brown. The results obtained are: 1. Quality equal to Swedish from any non-sulphurous pig. 2. A yield hitherto unapproached, viz., 100 of pig produces much more than 100 of steel. 3. Speed of working is greater per furnace than heretofore. Possibly this speed will be 24 charges in 24 hours from five 20-ton furnaces, say, 480 tons of steel per day of 24 hours.—London Invention.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—EQUIPMENT OF STATION.

San Antonio, Jan. 23, 1897.

Electrical Age Pub. Co.

Dear Sirs:—The people in an adjoining district here intend to install a system of electric lighting. Kindly let me know which in your opinion is best—an arc, incandescent or alternating current? By giving this your immediate attention you will oblige,

Yours truly,
Andrew Silke.

(A.)—If the town is distributed over a large area use an alternating system for indoors and an arc in any case for street lighting. The low tension, continuous current is all right if the homes are grouped together.

(Q.)—LIFE OF LAMPS.

Pittsburgh, Feb. 1, 1897.

Editor of Inquiry Column.

Dear Sir:—The lamps we use in our factory burn very brightly, but do not last. Can you let me in to the secret of their life and durability? I would value the information from a financial and practical standpoint.

Yours respectfully,
Robert Calhoun.

(A.)—Lamps last in proportion to the energy they consume per candle-power. For instance—

A 16-c.p. lamp, taking 64 watts, lasts 1,200 hours.
A 16-c.p. lamp, taking 50 watts, lasts 800 hours.
A 16-c.p. lamp, taking 40 watts, lasts 400 hours.

These figures will bear criticism, but at least indicate the idea set forth. A lamp taking only 16 watts for 16-c.p. could not be guaranteed one hour. Either mechanical vibration, low wattage or poor construction ruins your lamps.

(Q.)—AMALGAMATED ZINCS.

Brooklyn, Feb. 1, 1897.

To Electrical Age.

Dear Sirs:—In setting up primary batteries I find the zincs dissolving very rapidly; how can this be remedied, and what is its cause?

Yours faithfully,
A Subscriber.

(A.)—Amalgamate the zincs by letting them rest a few minutes in a dilute sulphuric acid solution. Then let them be dipped into mercury until thoroughly coated. Use pure sulphuric acid in your cells and repeat this process with the zincs once or twice a day if used constantly. The cause is, impurities in the zinc forming local circuits with it. Pure zinc is exempt. Impure zinc requires amalgamation.

(Q.)—NUMBER OF LIGHTS ON A CIRCUIT.

Albany, Jan. 25, 1897.

Electrical Age.

Dear Editor:—Kindly let me know in your valuable Inquiry Column how many incandescent lights can best be burned on one circuit? The friends I have here think five quite sufficient.

Yours very truly,
Ernest Berange.

(A.)—The number of lamps to be burned on a circuit is decided in a private installment by yourself; the drop determines it. A lighting company will recommend only a certain number of lamps or amperes on a given sized wire. You can get their book and find this out yourself or consult a wire table.

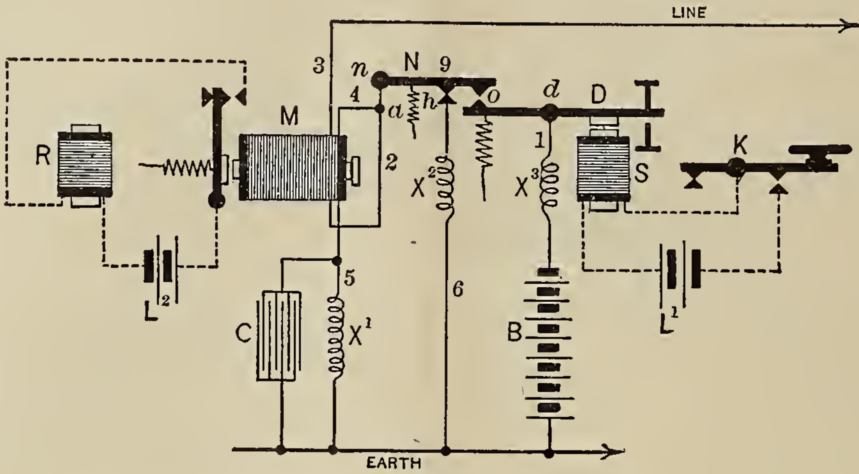
MULTIPLE TELEGRAPHY.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

It is a matter of considerable difficulty to describe within a limited space the principles of multiple telegraphy; yet by careful analysis it is possible to reduce the subject down to a few principles, the comprehension of which will involve the most intelligent appreciation of the methods employed in this marvellous system of telegraphy.

Relay.—A relay consists of an electromagnet whose armature, when attached to the poles of the electromagnet, closes a switch; that is, brings two contact-points together which open and close a small circuit containing a series of cells and the sounder. The original current coming over the line operates this relay, which a very weak current will actuate. At the end of a long line a relay will prove a most serviceable piece of apparatus, because the current it takes would never be sufficient to work a sounder distinctly, yet proves enough to move the armature of the relay a trifle, thus closing the independent, local circuit in which the sounder and new cells are placed. The sounder, by this means. gives a most emphatic signal perfectly audible and satisfactory.

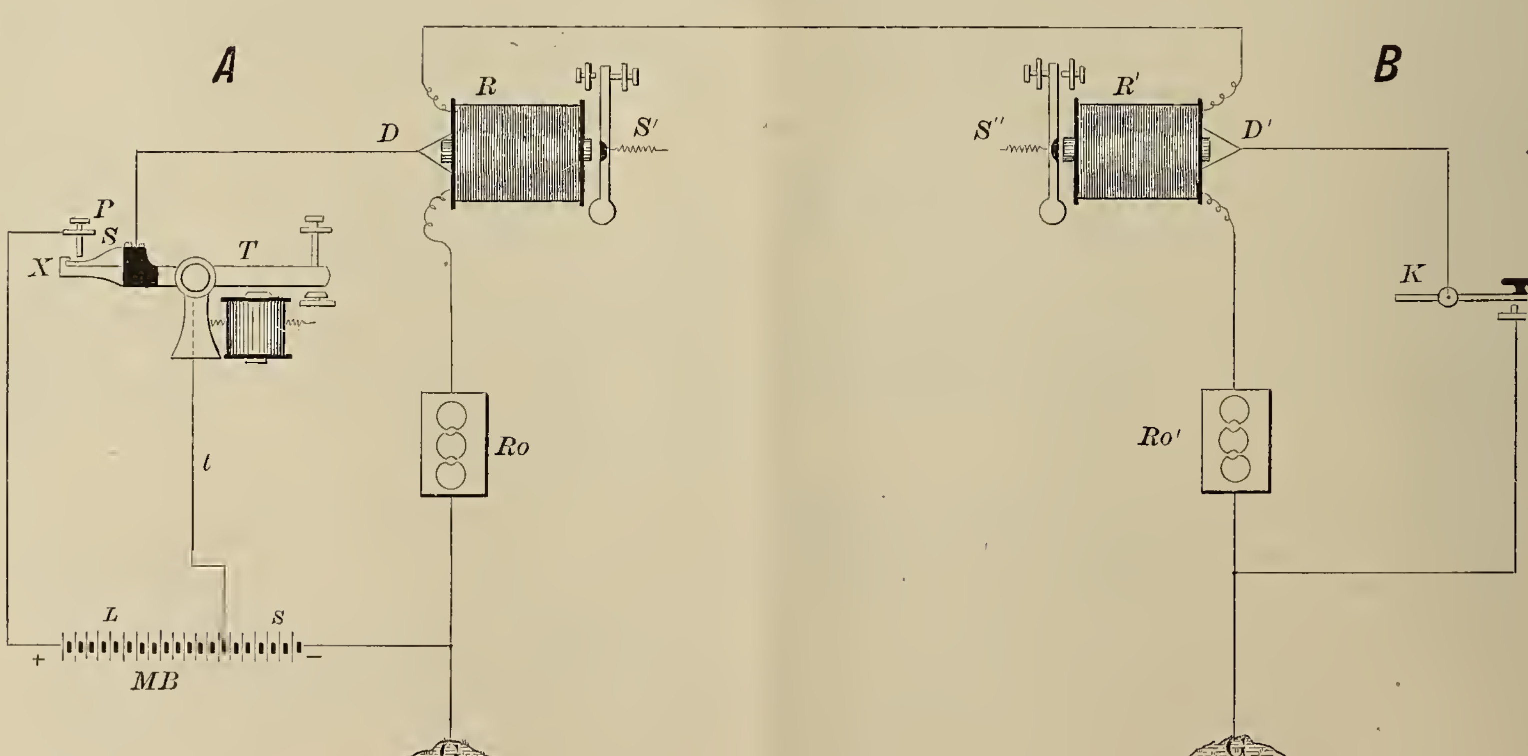


Single-Current Duplex.

This is the Diagram Referred to in Article,

Single-Message System.—A simple circuit, including within its limits a key, sounder and battery, offers no difficulties to the understanding. The line may be a double metallic circuit or it may consist of an overhead line with an earth return. To secure an earth or ground return, the extreme ends of the line are twisted around a gas or water pipe respectively, or attached to a metal plate sunk into moist earth and involved in a bed of coke, charcoal or scrap metal. But one message can be transmitted through a circuit of this description, and over but a limited length of line, if no accessories are added. The

PLATE XV.



STEARNS' DUPLEX WITH BATTERY AT ONE STATION ONLY.

longer the line the greater the battery power required to compensate for the leakage occurring throughout its length. It is impossible to send a current many miles without great loss; it therefore becomes necessary to employ a device called a relay to remedy this difficulty.

Importance of the Relay.—The entire practice of duplex and quadruplex telegraphy depends to a great extent upon the relay, modified, of course, to suit either, but still retaining its position and performing its functions as described.

Kinds of Relays.—There are several kinds of relays known under the names of

Neutral relays,
Polarized relays,

each of which may be wound with a form of winding that it is best to introduce now, called differential winding.

Differential Winding.—When a magnet core is wound with wire half way in one direction and the remainder in the opposite direction, a current passing through it would

(Continued on Page 88.)

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CONTENTS.

GAS ENGINES FOR ELECTRIC LIGHTING.

The various applications of power have always been an interesting study to the technical student. Not only the purposes to which power is applied, and which has had so much to do with its subsequent development, but the gradual evolution of kindred sources of power for industrial purposes.

The early experiments of Watt and the vast impetus given to his work by the efforts of Stephenson and Fulton made steam power the most common source of energy on this globe.

But in common with other things whose supremacy is due to its peculiar fitness at a particular time, the use of steam has in many respects been displaced by other power producers, amongst which may be found petroleum, gasoline, kerosene and gas engines.

The mining of coal was looked upon as a necessity when, in the course of this earth's history, manufacturers and railroad men used it for the production of steam. It was not long before the kindred bi-products were examined as to their respective values and, one by one, each found a place in the industrial arts.

The general use of gas as an illuminant has had much to do with the widespread acceptation of it as a convenient source of mechanical energy. The use of it in many homes for light and heat makes its introduction for other purposes a foregone conclusion. And in this respect the peculiar adaptation of the gas engine to power-producing purposes within the home has become a common event.

There is, then, no opposition to its use for electric lighting provided it does not infringe upon the limits of economy or cause excessive expense.

The use of heavy gas engines of 500 h. p. has become a feature of station practice in Germany. In this country, in which one might almost say we find the home of the gas engine, such applications have not been made. The conclusions arrived at by Messrs. J. L. Christy, M.E., and S. A. Hasbrouck, M.E., are valuable. They show the drift of modern progress and its inevitable effect upon the art of electric lighting.

The glorious light of the north, as seen by those that have ventured beyond the limits of human habitation, survives the memory of all else. The aurora borealis—now streaming across the heavens with ghastly flickerings, now blazing forth with the fury of a vast conflagration—undoubtedly has its origin in some electrical disturbance of a far-spreading nature. During the long, dark days of blighting cold, when fearful storms rage with shriek and cry, and the ice hut of the Eskimo sinks from sight beneath the heaping coverlet of snow, the dreamer within sleeps on—for the storm and rushing wind will pass away, the northern constellations gleam in the black sky, and the pale, quivering flash of northern lights scintillate and fade, above, in the widespreading arch of heaven.

What is the cause of this wonderful light, this cold corona of the far north? It would be looked upon today as an unsolvable mystery were it not for a few facts with which we try to reason out its probable origin. It would seem strange to say that the sun plays its part in bringing into existence this earthly halo. Yet, by some means or other at present entirely unknown, the storms that rage at the sun's surface, that cast out fiery waves thousands of miles in height, take effect upon this puny earth and make it thrill from pole to pole. The magnetic needles are violently shaken, the pole appears to palpitate and the warning light of the aurora flames out anew with a most transcendent glory.

Across millions of miles of space the sun has sent a touch of its own agony. The slumbering powers of the earth are awakened, and the ice fields relit by the cold fires of the north. The sun with its cyclonic storms, the centres of magnetic force, and the nimbus that crowns the snowy tracts are all united by some mysterious bond—some kinship that reaches across the very abyss of space. In these ice-bound regions lies the body of John Franklin and his ill-fated crew. Beyond is seen the unfortunate ship Jeannette. On their all but forgotten graves—in the silence of death and desolation—the aurora sheds its cold and ghostly gleams.

The Amazon Cable Impracticable.—Consul Matthews writes the department of state from Para that the Brazilian government is having a hard time in trying to operate the new cable to Manaos. The cable, costing about $1,000,000, was guaranteed by the company for thirty days. On the thirty-first day it failed, and no message has been sent over it since last February. It is hoped to have it in working order by the end of the year. Engineers now assert that a cable up the Amazon cannot be made a success on account of the current and many obstructions in the river bed. The cable is of Siemens make, and one of the best ever laid, but the conditions are said to be worse than those encountered even by cables in the busy Hudson River.

To disinfect rooms or closets a device composed of a rotary fan, run by an electric current, has just been invented. The blades of the fan are covered with an absorbent material, which is kept moist by the liquid disinfectant, the revolution of the fan throwing gas therefrom into the air.—Philadelphia Record.

produce no magnetic effect. One set of turns would neutralize the other and the magnet or relay remain unaffected.

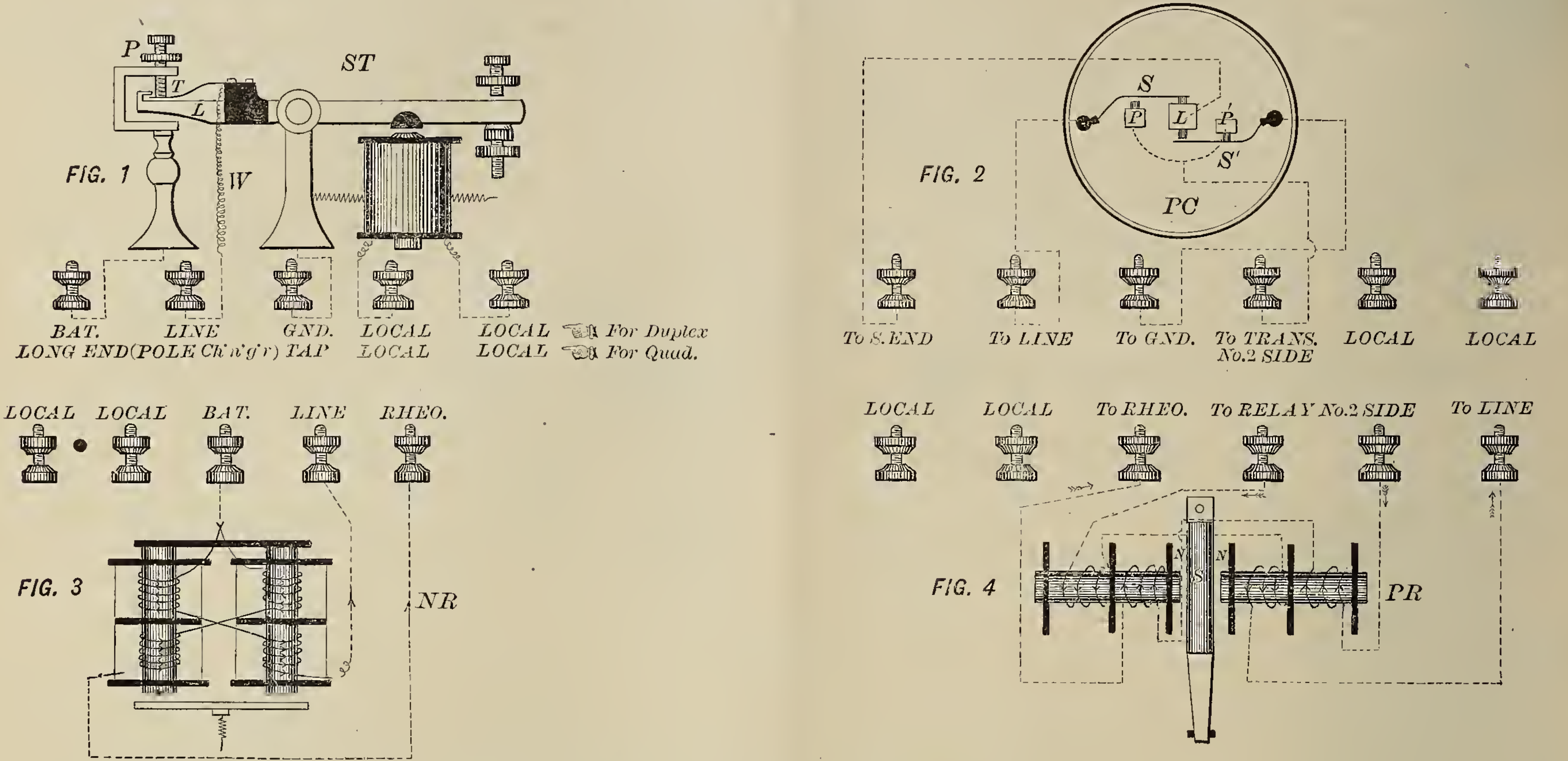
Duplex Telegraphy.—This system of *sending* and *receiving* a *signal* at the same time over *one* wire is possible in the following manner:

Capacity,

the other grounded to the earth requires an artificial equivalent of the same. A condenser and a rheostat are therefore inserted between it and the ground connection.

Artificial line.—When a current is sent out, one half

PLATE XIX.



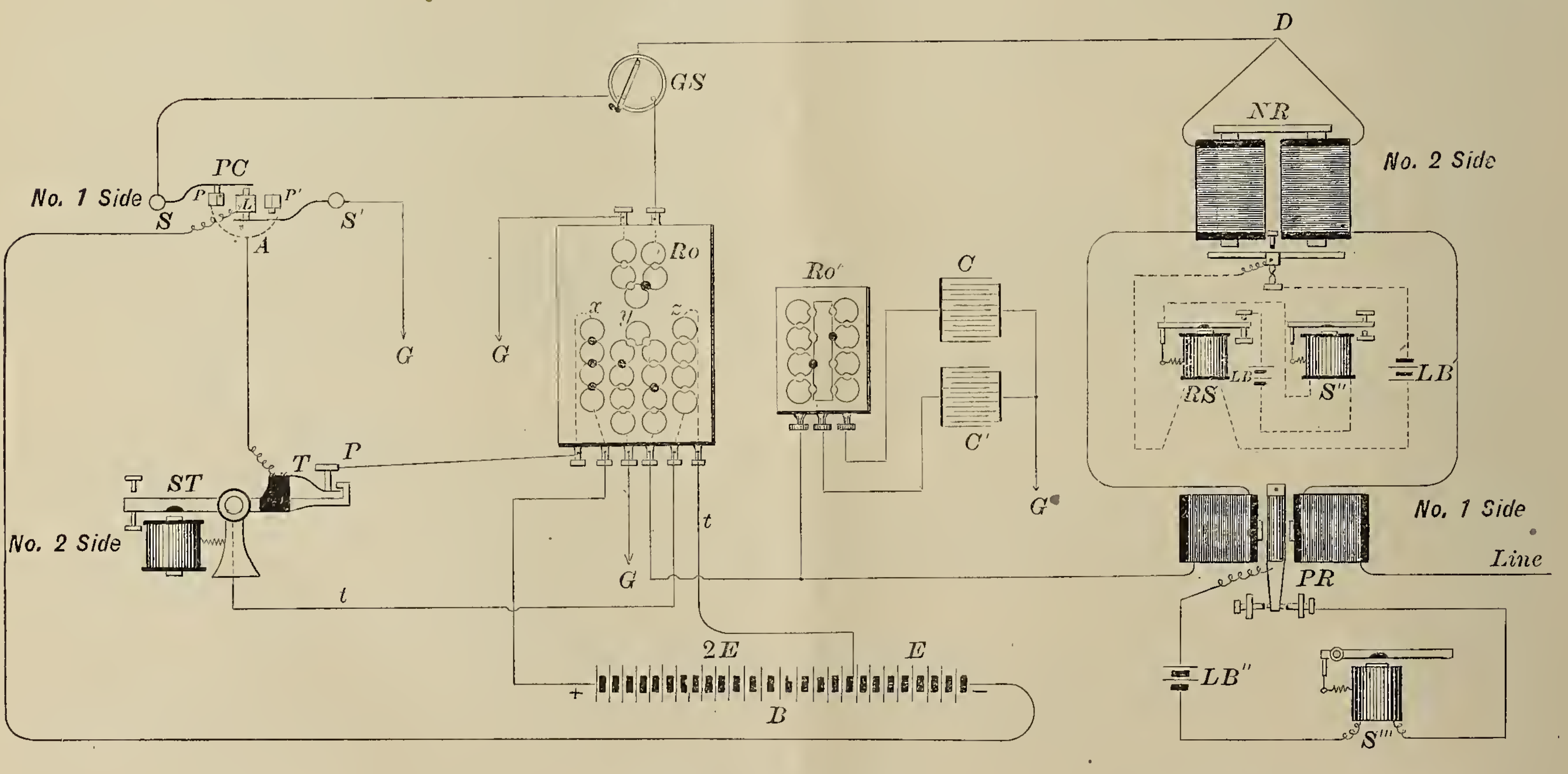
DUPLEX & QUADRUPLEX APPARATUS.

Home end unaffected by outgoing signals.—The operator desiring to send a message out does not want his relay disturbed under such circumstances. If the relay used is differentially wound, and the current is sent through it, the outgoing signal leaves it unaffected.

goes through one of the windings of the differential relay and then on to the main line; the other half passes through the remaining winding to the earth.

Current in each winding of differential relay alike.—By this balancing up of the real line by artificial means the

PLATE XVII.



THE QUADRUPLEX.

MATTHEWS, NORTHRUP & CO., ENGRS. & PRS., BUFFALO, N. Y.

Balancing the line.—The differential relay is supplied with two opposite windings; when the current issues from the station it is necessary to preserve each winding of the same strength, the one connected with the outside line and the other connected to the earth. If one of the differential windings connects to the line which possesses

Resistance and

current is equally split in each of the relay windings and it is totally unaffected by an outgoing signal.

Direction of current and signal.—It may be known that a false opinion prevails regarding the direction of a current and a signal. It is not necessary to have both current and signal moving in the same direction. A signal sent from one end of a line may be due to a current leaving the other end, and *vice versa*.

In this case the single-current duplex, the outgoing current, leaves the station unaffected; but it is still sensitive to signals sent in from the other end, although these signals are only received by more current being drawn from the first end.

Diagrammatic Explanation.—In the diagram these principles are illustrated as follows:

(1) Signal sent out: K is depressed,
D is attracted,
O is lifted,
B supplies current to point *a*, where it divides between 4 and 2; one half through differential winding and 3 to line; the other half through differential winding, 5, C and X to earth. Result, relay unaffected.

(2) Signal being received.
Batteries at other end in series with B,
K depressed at other end,
More current drawn from 3 station sending signal,
Strengthens one of the differential windings;
with the result that relay operates and works its sounder. Both keys at each station may be simultaneously pressed, yet each station receives what the other has sent without interference.

The technical names of the principal devices used in this system are the—

Transmitter . . .	K
Differential Relay . . .	M
Rheostat	X'
Condenser	C

It is absolutely necessary to keep the line balanced at each end, otherwise the *sending* of signals is *impossible* without working the relay.

Signals travelling in opposite directions do not mean *currents* opposing each other. In this system, according to diagram, the current producing a signal passes through line, 3, 2, n, 9, 6 to earth.

ELECTRIC ORE SEPARATION.

SEPARATION AND CONCENTRATION OF NON-MAGNETIC ORES.

Among the most interesting topics brought before the Chemical Section of the Franklin Institute at its last meeting was the subject, "Recent Developments in the Magnetic Treatment of Ores," by H. C. H. Nitze. This paper dealt with the mechanical concentration and separation by means of powerful and specially-devised electromagnets of various mineral and chemical substances of such low magnetic permeability as have usually been called non-magnetic. These separations may take place from each or from absolutely inert substances. There are several commercial concentrations acting on ores ordinarily known as magnetic, but this particular apparatus treats successfully ores which are not capable of being lifted by ordinary permanent or electromagnets. A large model of this machine, known as the Wetherill concentrator, was exhibited in operation with iron and zinc ores and monazite. The distinguishing feature of this apparatus as compared with other magnetic separators is that, owing to the intensity of the magnetic field acting on the ore particles, the ores when fed between the magnet poles, while not attracted to the magnet, are deflected towards it, and thus fall into brass chutes, where they are carried to receiving pockets; while the inert substances fall perpendicularly.

The apparatus consists of specially-designed electromagnets producing intense magnetic fields, and means for conveying the crushed ore to and feeding it into such field, and also means for preventing the ore particles from sticking to the magnet poles and thus obstructing its operation. The magnets, weighing about 1,200 pounds, are wound with about 915 ampere-turns at 25 amperes. The chief cost of the process is in the crushing and sizing of the ore. The ores, though not ordinarily considered magnetic, are treated with but small cost for electrical energy, the exciting current being from three to eight amperes, and in rare cases as high as twenty-five. Such ores as franklinite, red hematite, brown hematite, chromite, rutile, pyrolusite, rhodomite, garnet, hornblende, pyrite, siderite and limonite, etc., may be commercially treated. This system is being installed at the new Sterling Zinc and Iron Company's works, in New Jersey, in a plant having a capacity of 200 tons a day. An important field for this invention lies in the treatment of southern fossil iron ores. It has been urged that the comminuted state of the concentrated ore produced by this process would restrict its use in blast furnaces, but with the newest types of these this objection does not hold.

Dr. Joseph Richards read a paper entitled "Recent Determinations of the Electrical Conductivity of Aluminium," according to which it appears that 99.75 per cent. pure aluminium has a conductivity equal to 63 per cent. of that of hard-drawn, pure copper. Lyman F. Kebler, secretary of the Section, contributed a communication on "The Volumetric Estimation of Acetone." A new laborator grinder for agate-mortar work was also exhibited.—Philadelphia Record.

A Great Scheme.—The announcement is made, apparently in all seriousness, by a newspaper published in Washington, that Dr. B. H. Johnstone, a scientist of that city, intends to establish a diamond factory at Niagara Falls, where, by means of the great electrical power that will be available there, he will turn out gems to order of any desired size. That it is possible artificially to produce the crystallized carbon that is called diamond was proven some time ago, and has become generally known; but the artificial diamonds thus far produced are so very small that they are of no value as gems. Dr. Johnstone's idea is to use, not the impure carbon, such as charcoal, which has been used heretofore by the scientists who have experimented with the manufacture of diamonds; but the pure carbon that is found in the mines. He will require at least 6,000 volts of electricity to effect the crystallization of such carbon, and as power of that extent is not easily obtained elsewhere he will go to Niagara Falls to get it. He expects to be able to produce in a few days gems which through the natural process would require a million years to reach perfection. Anything desired in the shape of diamonds, from the ordinary solitaire to a gem like the kohinoor, will be turned out of Dr. Johnstone's factory—perhaps.—Albany Express.

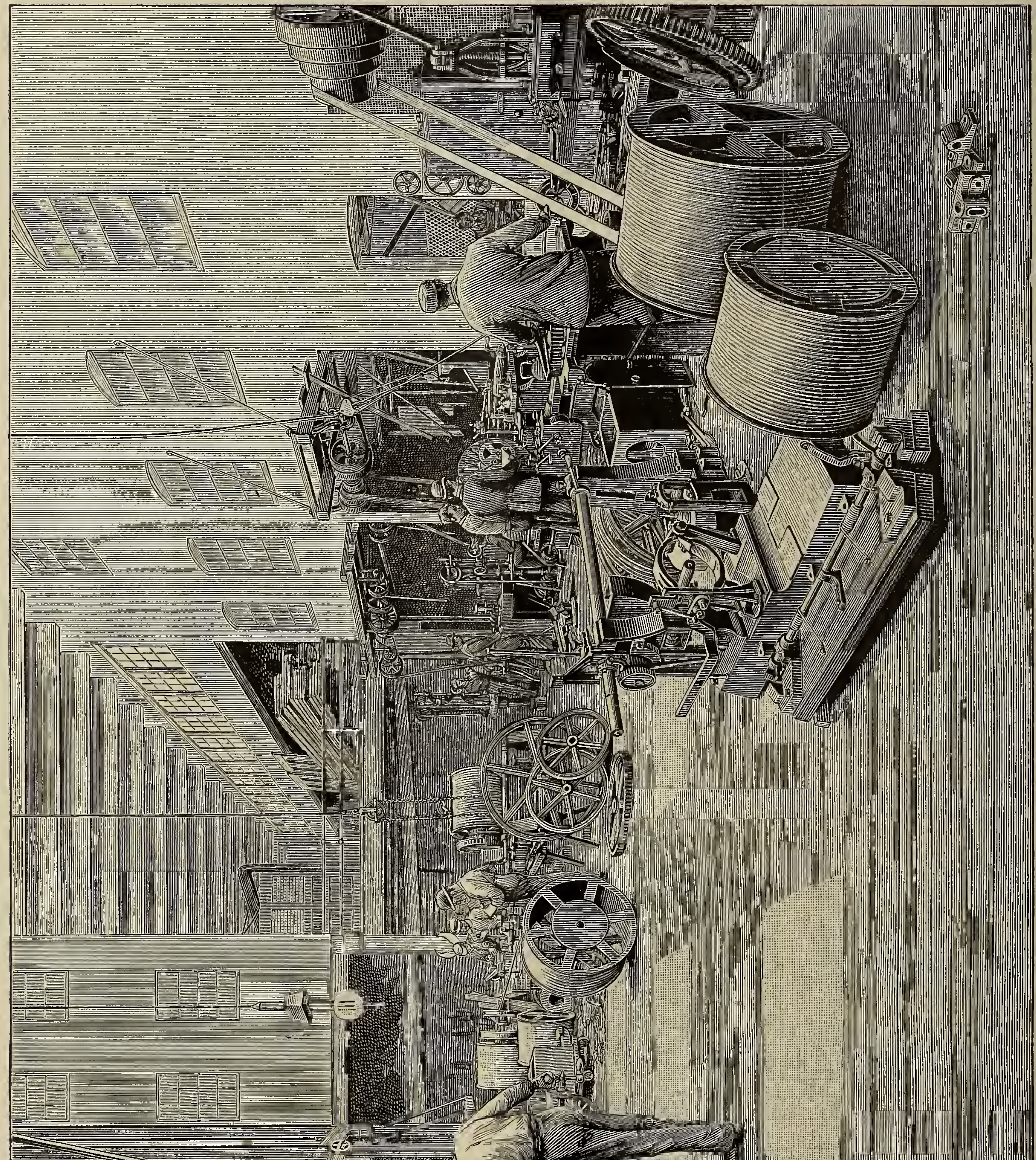
The Power of a Lightning Stroke.—The well-known Berlin firm of Siemens & Halske was recently enabled to estimate the actual power produced by a stroke of lightning, which melted a piece of iron the weight of which was known. A careful calculation shows an equivalent of seven thousand horse-power spent during one second. —Philadelphia Record.

GROWTH OF AN ENTERPRISING ELECTRIC ELEVATOR MFG. COMPANY.

The A. B. See Mfg. Company, of Brooklyn, N. Y., manufacturers of complete electric elevators for passenger and freight service, have bought all the property surrounding their present factory on the southwest corner of Front and Pearl streets, 102x140 feet, and are remodelling it to meet the requirements of their increasing volume of business. The corner rooms on the main floor are being altered for winding motors, fields and armatures and fin-

ishing motors of all sizes from 110 to 500 volts. A portion of this department will be used for storing a full line of all sizes of motors for immediate orders.

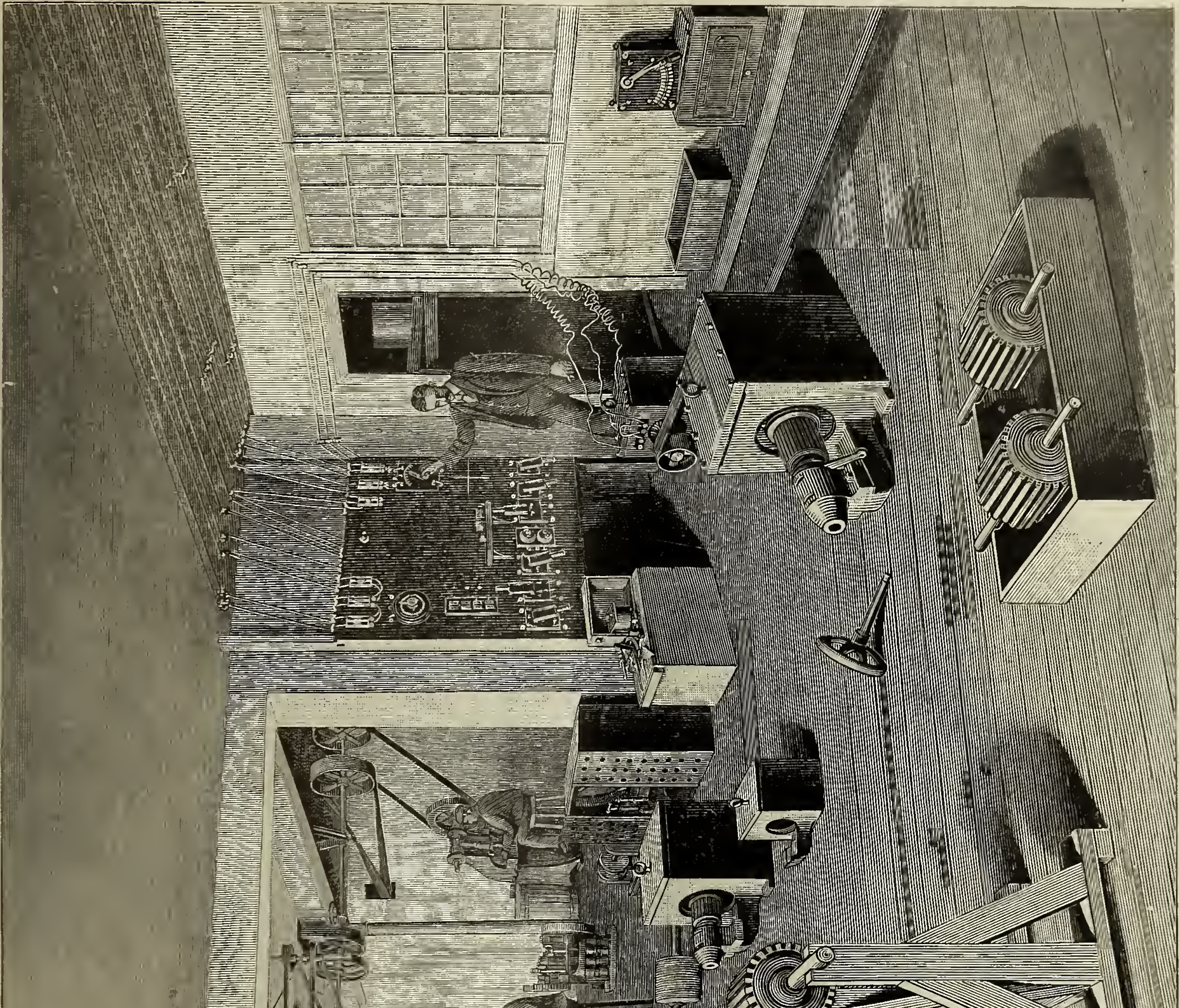
The second floor is being fitted out in light colors for street side of main floor is being equipped with heavy machinery for boring out motor frames and all parts of the elevator machinery. The boiler and engine rooms are south of the machine shop. A 75-h. p. T. H. gener-



Main Machine Shop.

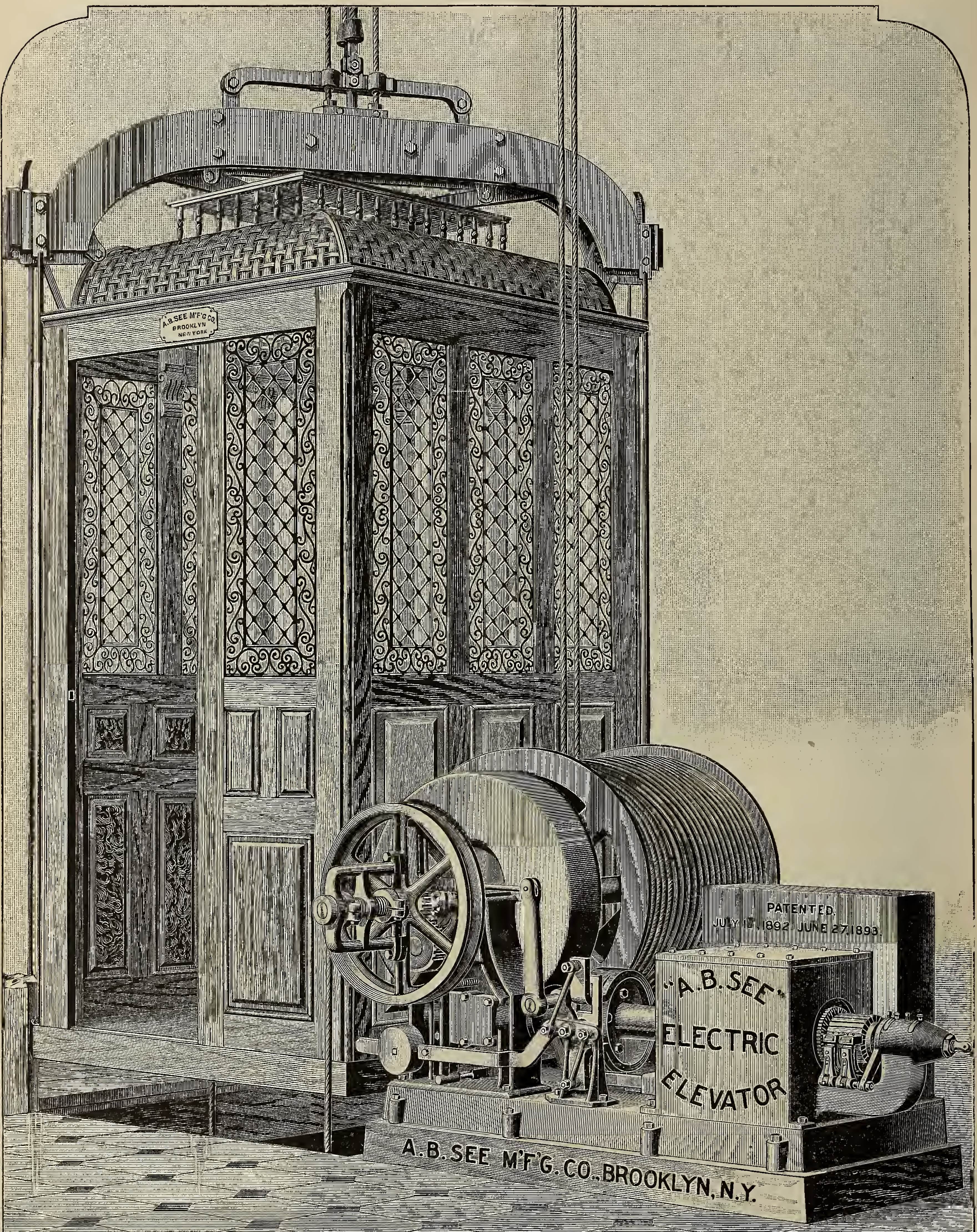
the drafting department and manufacturing of their automatic elevator switches. The office will be retained in the present department, No. 116 Front street. The Pearl ator has been set in place and will be used for running the motors throughout the different departments, which are connected to various machine tools. The centre of

the building, 60 by 100 feet, is the erecting room, in which is to be installed an electric travelling crane. To the left of the erecting shop is the machine tool department. The second floor in the rear is used for the storage of lumber and for the erection of passenger and freight elevators, pattern shops and woodworking departments. The roof over these departments will be raised to give more light and ventilation. One particularly interesting machine run by their electric motor is used for cutting the grooved timbers used for guides in elevator shafts. Wherever you turn motors are set in convenient isolated parts of the building running machines for iron and woodwork of every possible nature used in the construction of elevators. All the motors are of their own construction and



View in Electric Motor Factory.

are of the ironclad type, so much in demand today for light and power work. Speaking of the business Mr. A. B. See escorted the writer to Adams street, one block away, and showed him the little one-story building, Nos. all of the very best throughout. With the use of their specially wound motors and automatic switches their elevators can be operated by an unskilled attendant, and all danger is obviated. The elevators start with a gradual



79 and 81 Adams street, where they started building elevators twelve years ago.

The passenger elevators built by this company are all made from their own designs and the materials used are speed and stop gracefully and easily, overcoming all jars or jumps which are prevalent in some elevators. The largest and finest private and public buildings in New York and Brooklyn and surrounding cities are fitted out

with these elevators. A list of users will be sent upon application.

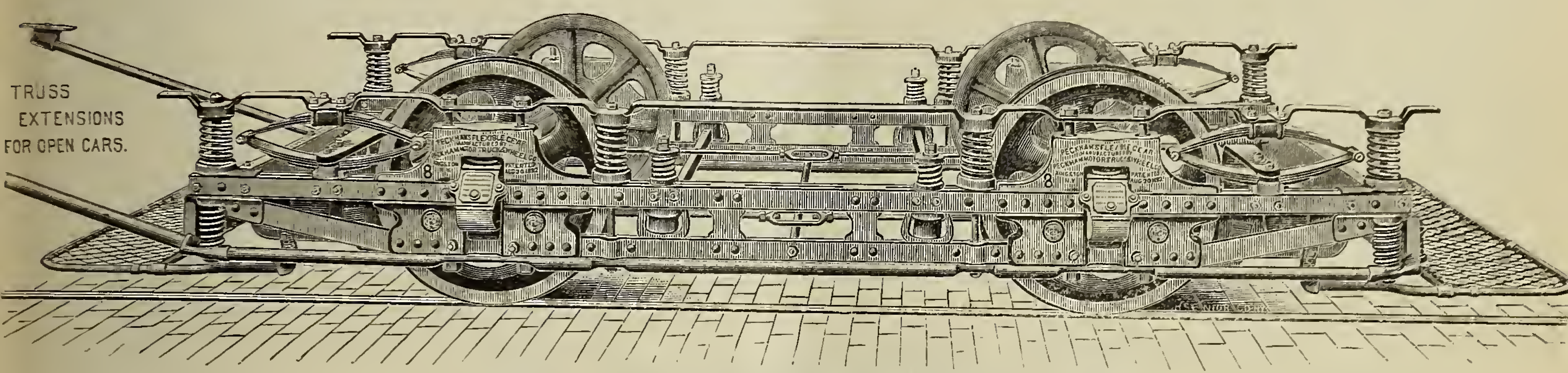
The A. B. See Manufacturing Company makes a speciality of electric elevators, building every part of the elevator in their own factory and entirely under their own patents. This company early saw the great future of the electric elevator, and determined to invent and put on the market an electric elevator that could be operated as easily as any other type of elevator then in use—an elevator that could not be made to arc in stopping, that could not be suddenly reversed nor have the current thrown on the motor suddenly. This was thought to be an impossibility until the "A. B. See" electric elevator was put on the market, and to this is largely due their great business success. Purchasers at once appreciated the great advantage of an electric elevator that was freed from the disagreeable buzzers or flashing lights, which up to this time had been used on electric elevators and which was thought to be necessary to guide the operator in the car when stopping and starting the elevator.

Success in largest measure always comes to those who leave the beaten tracks and start out for themselves along new lines, and so radical a change and so marked an improvement in an industry as that made by the A. B. See Mfg. Company must of necessity mean a vast increase of business and of business prestige.

THE PECKHAM TRUCK COMPANY.

Thousands of miles of road reach in and out of the nooks and crannies, main roads and side streets of large cities. Between each centre of life and activity a myriad of lines extend, stretching far and wide as part of the conformation of a vast web—a great industrial web, upon whose filaments we are carried back and forth thousands of times in the course of our existences.

The safety and ease with which we are transported enters into the sum total of our happiness as an important factor. Women and children, invalids and the chronic sick, would look with horror upon a journey if it were not for the efforts of those who have devoted themselves to the task of procuring comfort and ease to the traveller, and whose ingenuity and persistent energy eventually made travel in cars a pleasure. The thump and jolt have gone and the disagreeable swaying and oscillation are things of the past.

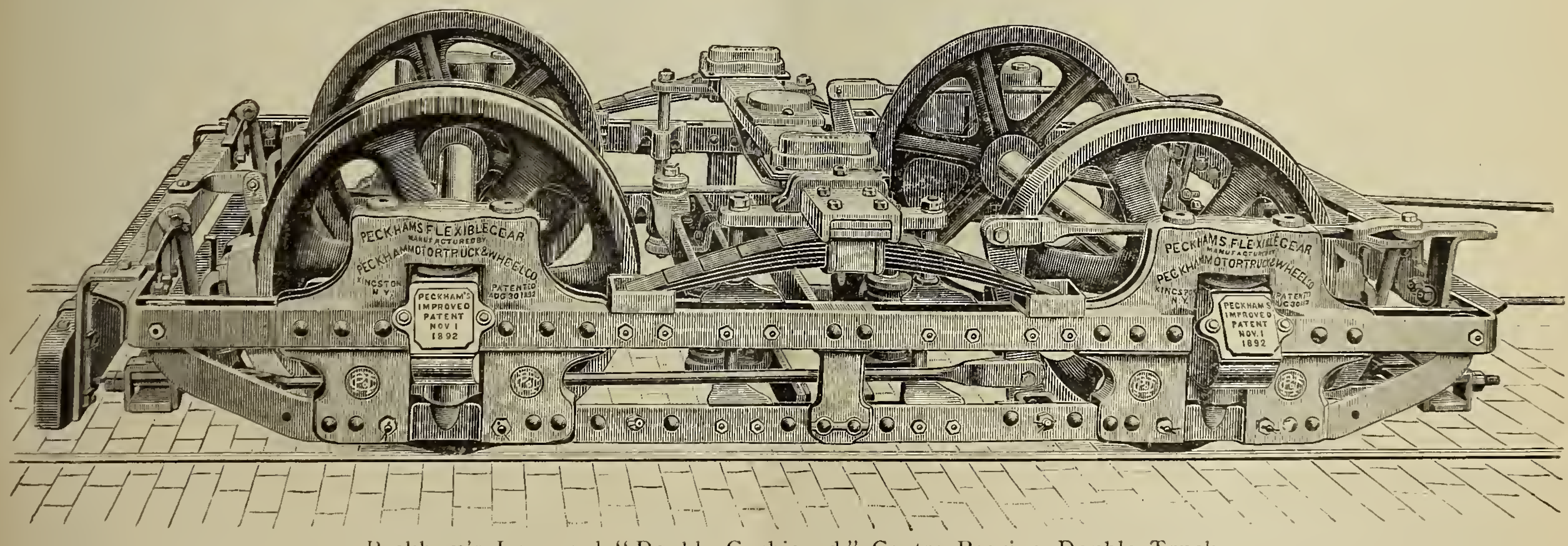


Peckham's Improved "Standard" Cantilever Extension Truck.

Edgar Peckham, to whom so much of the present luxury of travel is due, is the originator of the Peckham Truck. The different classes of power vehicles that call for trucks and their appurtenances can be chosen from the following list manufactured by this concern:

Cantilever extension trucks,
Interchangeable cushioned trucks,
Motor axles, life guards,
Emerson's truck scrapers,
Ruggles rotary snow-plow,

for electric, cable and steam cars.



Peckham's Improved "Double Cnshioned" Centre Bearing Double Truck.

The illustrations represent the appearance of two trucks, the first, called Peckham's improved "standard" cantilever extension truck, is constructed with *hot rivets*, driven by a pneumatic riveter, with bearings and bolts machine fitted. It is supplied with an improved truss for open cars, and is supported upon journal boxes by graduated spiral springs. Pounding and crystallization of rail joints are thus prevented.

New York City.—Negotiations looking toward the consolidation of the three electric light companies on Staten Island are under way. Col. G. B. M. Harvey made the following statement yesterday: "While there has been no definite consolidation, the negotiations have been successful.

"The Richmond Borough Electric Company, which was incorporated by Erastus Wiman; the Richmond County Electric Light Company, which was started some months ago by E. P. Doyle, and the Port Richmond Electric Company, which was started and is owned by Mr. Boardman, Mr. Gamon, and their associates, will go into the consolidation.

The Peckham patent adjustable life and wheel guard is supplied at an extra cost of fifteen dollars per truck for both ends. The noiselessness of this truck is truly remarkable and speaks well for the scientific care taken in its general construction.

The second illustration is that of the Peckham improved "double-cushioned" centre-bearing double truck. It is purposely designed for long, open or closed car bodies, and high speed service. Similar in general principles to the cantilever extension, it embodies the most desirable features of steam railroad practice.

Likewise constructed with hot rivets, power driven, side frames spring supported and journal boxes dust-proof, it represents a substantial, reliable and most satisfactory style of double truck.

With its short wheel base it possesses the even motion of a steam road palace car truck. There may be technical points brought forward without end in analyzing the excellent mechanism of these trucks. The double-compound lever brakes, with their tenacious grip and the details of their construction, might also awaken interest. But with this rapid sketch we merely hope to give a faint idea of the general qualities that stand prominently forth in the design of Peckham apparatus.

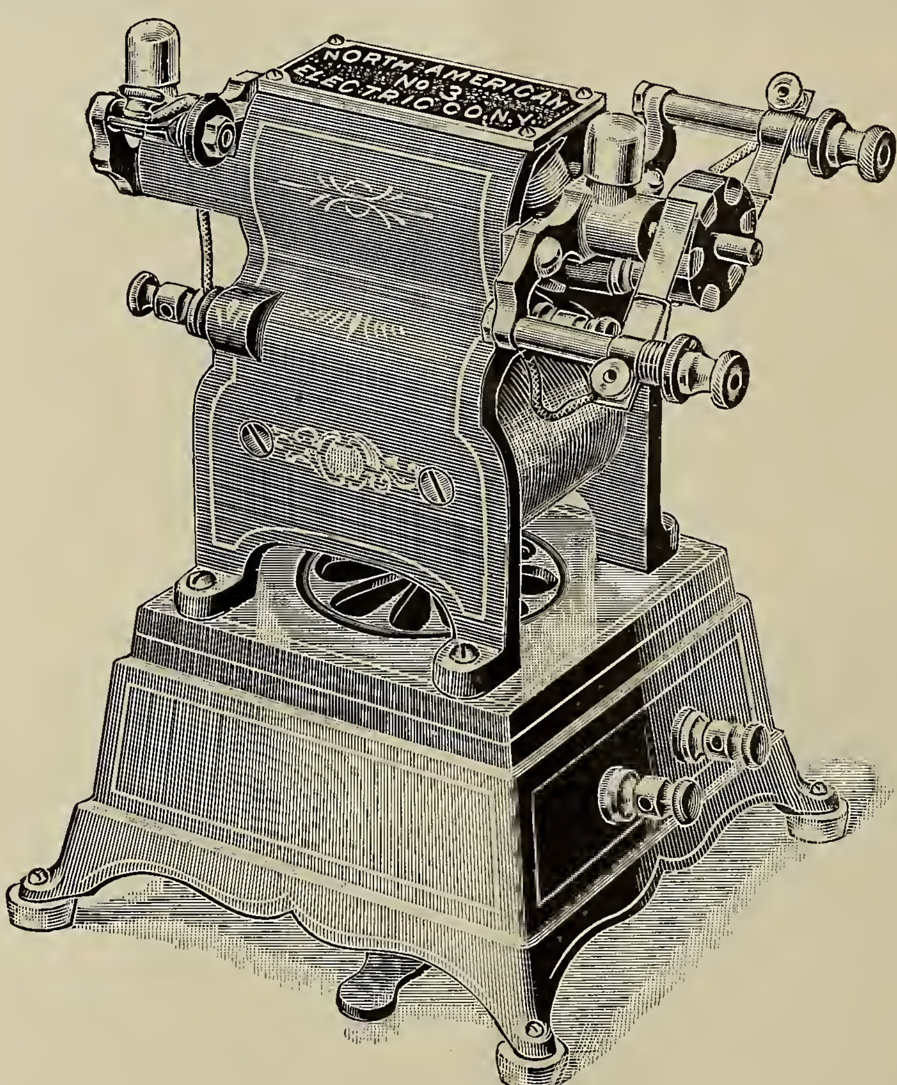
X RAY MOTOR.

The neatest attachment conceivable has been brought out by the North American Electric Co., 181 William street, New York. It consists of their finely furnished and beautifully mounted motor with a break-wheel attachment, to be used instead of a vibrator for large Ruhmkorff coils. These excellent and substantial machines are decorated with black enamel, have bronze bearings and mountings and a well-fitting shaft. Their smoothness of operation is a great feature, which, with the switch and break-wheel attachment, makes them particularly convenient to owners of X ray outfits. They are built for either incandescent or battery current. The ingenuity and neatness of this motor, along with the other motors this company manufacture, is an eloquent testimonial to their great merit and serviceability.

OBITUARY.

E. CARL BREITHAUPT.

Mr. E. Carl Breithaupt, an electrical engineer of Berlin, Ontario, Canada, died there on Wednesday, aged about thirty years. Mr. Breithaupt was well known in Baltimore, having been for two years a post-graduate student in the electrical department of the Johns-Hopkins University, from which he was graduated in June, 1892. His preliminary education was obtained at the North-western College, Illinois. After graduating from the Johns-Hopkins University he became a member of the Beta Theta Pi fraternity of that institution. Mr. Breithaupt went to Berlin and became the electrical engineer of the Berlin Gas and Electric Light Company and president and general manager of the Berlin and Waterloo Railway Company. He was for some years a member of the executive committee of the Canadian Electrical Association and was last year elected vice-president of the association. He was also a member of the American Institute of Electrical Engineers.—Baltimore Sun.



X-Ray Motor with switch and Break Wheel Attachment for Incandescent or Battery Current.

A Syndicate Wanted.—To company promoters in search of something really striking to attract public attention we venture to throw out a suggestion. Out in Natal, in a pool near the Inanda Falls, "a party from Durban" has discovered what is described as a "lamp-snake," whose eyes are stated to be "two large illuminants, equal to 32-candle electric power." This is an opportunity not to be missed. A syndicate ought promptly to be formed to capitalize the snake at, let us say, £3,000,000 sterling, of which £2,700,000 should go to the vendor, leaving £300,000 available as working capital to buy up any other snakes with eyes of more than 32 candle-power. We are perfectly sure that the snake in question, if approached in a reasonable spirit, would be delighted to place himself at the disposal of the syndicate; and he might even be persuaded to join the board after allotment.—The Rialto and London Invention.

L. H. Hart, well known by the familiar name of Lou Hart in the trade, died Jan. 25, at his home in Brooklyn. Services were held under the auspices of his lodge of Odd Fellows. Among those present were a large number of the electrical fraternity.

Mr. L. H. Hart was an old friend of the president of this paper, and we, destined to witness his final exit, testify to the sorrow and grief his departure has caused us. It is our happiness to state that those who knew him recognized his perfection of character, happiness of disposition and charity of sentiment. His efforts in establishing the publication known as "Ventilating and Heating," and his success brought deserving praise. Now that it has pleased the Deity to still his pulsing heart, let his name, a name that we shall always respect, be kept in our minds as a pleasant memory of one whose example it shall ever be our desire to emulate.

THE TRADESMAN.

We received under separate cover a copy of the 18th annual number of The Tradesman, and commend the same to our readers' attention. They will find its contents of very great value and of great service for reference during the year. It contains the most complete and valuable review of the South and its resources ever presented.

POSSIBLE CONTRACTS.

Hagerstown, Md.—The Hagerstown Electric Company has purchased ground and will construct a new 800-horse-power electric plant, 80 by 130 feet, 30 feet high.

Boston, Mass.—A six-story store and office building is to be erected at the corner of Charlestown and Beverly streets, by Edward Doherty, of 50 Charlestown street, from plans by C. J. Bateman.

Utica, N. Y.—The projectors of the Bath and Hammondsport Electric Railroad, which will follow the east side of Keuka Lake, through Wayne to Penn Yan, have secured the right of way from Savona to Keuka. It is said that there is no question that the road will be built this spring.

Morristown, N. J.—The subway commission, Alderman Hurtzig, chairman, appointed by the board of aldermen of Morristown, N. J., to investigate the question of compelling all overhead telephone, telegraph and electric light wires to be placed under ground, has decided it is practicable to put the wires under ground and will draft an ordinance to that end.

NEW CORPORATIONS.

Albany, N. Y.—The Catskill Electric Railway Company has been incorporated to operate an electric street surface railroad line two miles long, from Catskill to Jefferson, Greene county. Capital, $30,000 and directors, Charles S. Williamson, M.D., Wm. R. Robert, Louis E. Robert, Michael W. Conway, William C. Courtney, William C. Wood and Howard A. Mock, of Brooklyn; Daniel W. Sharpe of Catskill, and Schuyler W. Mattison of Newark, N. J.

Articles of incorporation have been filed with the secretary of state by the Bay Shore Electric Light Company. Capital stock, $10,000. Directors for the first year, Josiah Robbins, Freeman T. Hulse, William W. Hulse, Lelah T. Clock, Eugene P. Strong, and John R. Howell, all of Bay Shore, and E. B. Mowbray, of Brooklyn.

NEW TELEPHONE COMPANIES.

Springfield, Ill.—The secretary of state has licensed the incorporation of the Jackson Union County Telephone Company, at Anna. Capital stock, $35,000. Incorporators: W. H. Cisne, C. T. Maris, C. M. Brock.

Albany, N. Y.—The Walton Telephone Company has been incorporated to operate a telephone line in Walton and connecting the villages of Delhi and Deposit. Capital, $4,000. Directors: S. P. Wilber, George Paine and J. R. Honeywill, Delhi; J. K. Munn, Fred C. Ward, Walton and others.

TELEPHONE NOTES.

St. Louis. Mo.—It is the intention of the Home Telephone Co., of Baltimore, Md., to enter the local field of telephone competition and take part in the fight against the Bell Telephone Company's monopoly here.

St. Louis, Mo.—New York dispatches announcing that the Bell Telephone Company contemplates entering the telegraph field as an active competitor of the Western Union Telegraph Company in the event of the latter opening long distance telephone lines in opposition to the Bell Company are pronounced by General Manager Geo. F. Durant of the Missouri Bell Company to be absolutely without foundation in fact.

Pittsburgh, Pa., Jan. 25, 1897.

The annual meeting of the stockholders of the Standard Underground Cable Company was held at the company's office, Room 61, Westinghouse Building, at 2:30 o'clock P. M. today, over ninety per cent. of the capital stock of $1,000,000, being represented in person or by proxies.

The old board of directors, of leading Pittsburgh financiers and manufacturers, was re-elected for the ensuing year, among them being one prominent gentleman who entered the board during 1896, namely, Hon. B. F. Jones, of Jones & Laughlin's, Ltd., one of the largest iron manufacturers in the United States.

The report of the board of directors showed a total business of nearly three-quarters of a million dollars for the year 1896; four dividends of two (2) per cent. each were paid out of the earnings for the year, and the remainder was added to the surplus account.

The assets of the company aggregate $1,412,046.06, and the liabilities, exclusive of capital stock, are $106,925.08, while the surplus over and above all liabilities (including capital stock of $1,000,000.00) is $308,107.19.

The company's factories are reported in first-class condition for economic and rapid manufacture of wires and cables of all kinds, all departments running, and the rubber department being especially crowded with orders at this time.

The prospects for 1897 are considered very flattering, a number of large contracts, aggregating nearly $250,000.00 being now on the company's books, most of which have been secured since January 1, and covering all classes of this energetic company's products. A specially gratifying feature pointed out by the board of directors is, that the number of customers on the company's books for the year 1896 is fifty per cent. greater than for any previous year.

The newly elected board of directors will probably meet on Saturday next, at which time it is expected that the present officers will be re-elected to their respective positions. The company's branch offices are managed by experienced men in this line of business, viz.: New York office, Geo. L. Wiley, manager Eastern sales department,

assisted by T. E. Hughes, as manager of the bare and insulated wire department; Philadelphia office, 336 North Broad street, E. W. Dugdale, superintendent of construction; Chicago office, the Rookery, J. R. Wiley, manager Western sales department, including St. Louis, Mo., Security Building, with F. C. Cosby as assistant manager.

BALL & WOOD CO.

The Ball & Wood Co. are occupying their handsome new suite of offices, 120 Liberty street, N.Y. They cover the greater portion of the building facing south, overlook-New York harbor.

The situation of the rooms is as follows: At one end is the clerical department, next to which is Mr. Wood's private reception room. Adjoining this is Mr. Vincent's office. This gentleman is a thoroughly alive business man and has the keenest scent for prospective orders. The room at the eastern end is devoted to correspondence, next to which is the engineering and draughting department.

With this new camping ground the hunt for game has gained a new stimulus. Any one desiring to cooperate with them can shoot as many orders as they please into their telephone. It has a most efficient receiver.

H. P. Ball Manufacturing Co., office, 101 Beekman street, New York; factory, Atlantic and Schenectady avenues, Brooklyn, are manufacturers of electric light, power and railway station switches, switchboards, panel boards, baby-knife switches and all appliances used on the latest designed boards. The yare just completed fifty panel boards for all the cable stations on the Third Avenue cable road, New YorkCity. The boards are two by three feet and are using from ten to sixteen switches, varying from twenty-five to fifty amperes each. Nine panel and one main switchboard were shipped to the Camden Armory, Camden, N. J.

Three handsomely finished slate switchboards with Weston meters, voltmeter switch of special design, two main and four double-throw dynamo switches, two rheostats, with handles on face of board, ground detector and two-light brackets on each board, were made for Harlan & Hollingsworth, of Wilmington, Del. The above are only a few of the large orders received since McKinley's election. That the high grade of workmanship is certainly appreciated is shown by the contract they have received for equipping the Woodbridge Building, William street, New York, notwithstanding the fact that their bid was the highest.

NOTE.

The Hazelton Boiler Company, New York, report having recently installed boilers in the plants of the North Adams Electric & Railway Co., North Adams, Mass.; the Bristol and Plainville Tramway Co., Bristol, Conn.; the Goodyear Rubber Co., Middletown, Conn.; the Central Railway & Electric Co., New Britain, Conn.; the Equitable Gas Light Co., New York City, and the Lambertville Spoke Manufacturing Co., Lambertville, N. J., aggregating 1,600 H. P.

The majority of these orders were received from old customers for enlarging their steam plant. The Hazelton Co. is now building 400 H. P. for Memphis Light & Power Co., Memphis, Tenn., in whose plant 1,000 H. P. of these boilers have been in successful operation for nearly six years. The Hazelton company is building a stock of 200, 250 and 300-H. P. boilers (these sizes being most popular with their customers,) in anticipation of a lively spring trade, and to enable them to give prompt deliveries. Numerous inquiries for prices, and recent sales, indicate that an active revival of business may be expected in the near future.

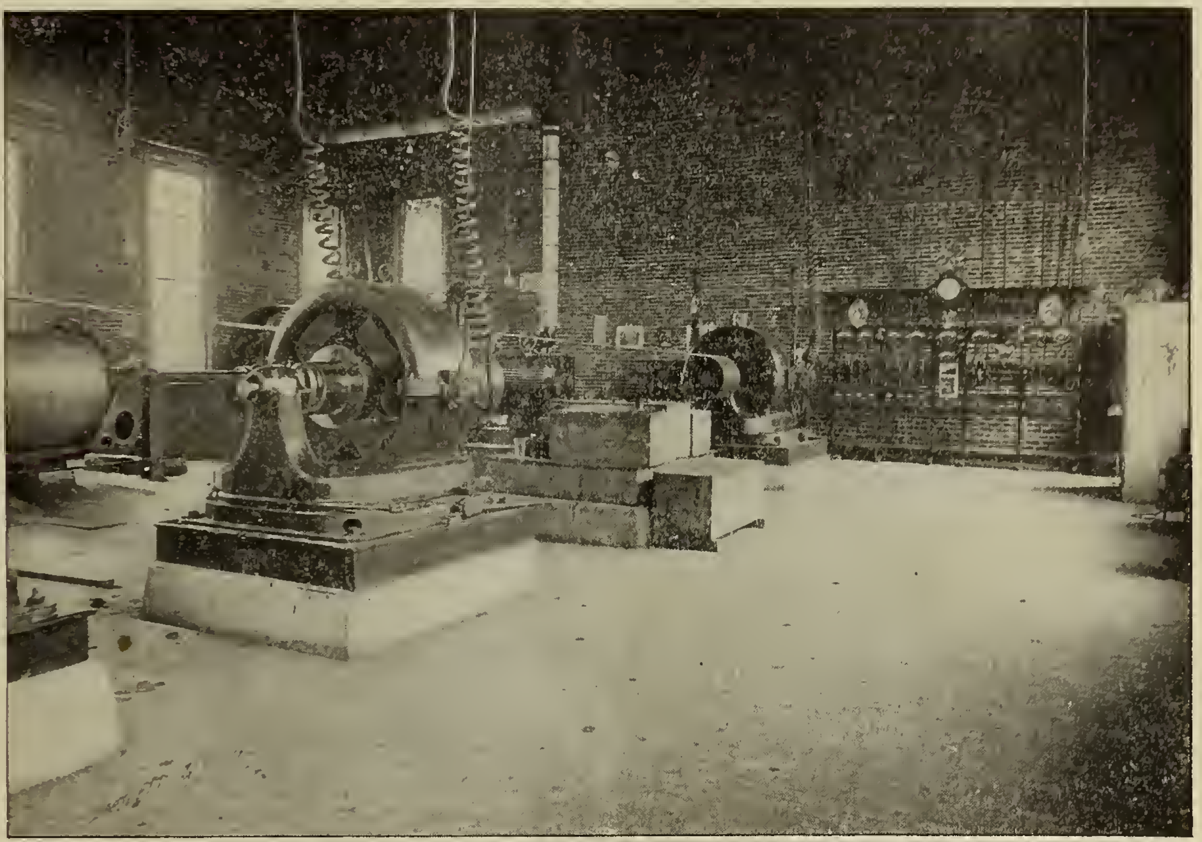
ELECTRIC STOCK QUOTATIONS.

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	35	38
Edison Illg. Co (St. Louis),	5	15
Eddy Electric Mfg. Company,	—	19
*Edison Elec. Illg. Co., New York,	105	106
Edison Elec. Illg. Co., Brooklyn,	98	100
Edison Ore Milling Co.,	7	10
Edison Elec. Storage Company,	28	29
Fort Wayne Electric Company,	3	3½
Ft. Wayne Elec. Co. T. Sec. Series A,	3	4
General Electric Company,	35¾	36½
General Electric Company pf.,	76	78
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	81½	82
Rhode Island Elec. Protec. Co.,	110	122
Toronto (Canada) Elec. Light Co.,	125	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4¼
Thomson-Houston Welding Co.,	5	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse El. & Mfg. Co., pf.,	50½	51
Westinghouse El. & Mfg. Co., assd.,	24	25

*Ex dividend.

The Electrical Age.

Vol. XIX., No. 7. NEW YORK, FEBRUARY 13, 1897. Whole No. 509



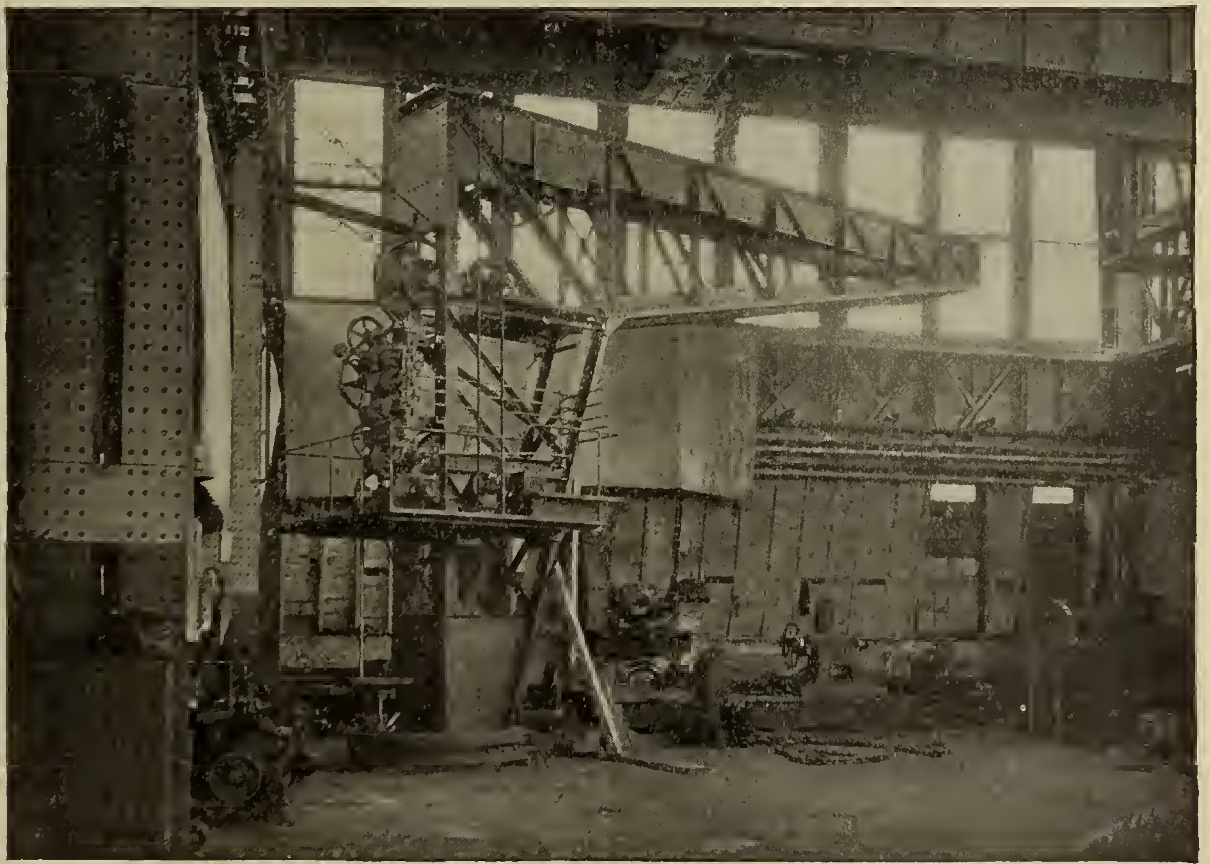
Power Plant, Granite City Steel Company, Granite City, Ill.—Three 100-Kilowatt 230-Volt Dynamos.
(CROCKER-WHEELER ELECTRIC CO.)

POWER APPLICATIONS.

But five short years ago, though the distribution of electrical energy from central stations and the installation of isolated plants for the supplying of electric lights had become a recognized practice and an established commercial industry, the utilization of this same energy for the supply of industrial power was still in its nebulous condition, and the marvellous possibilities in this direction comparatively neglected.

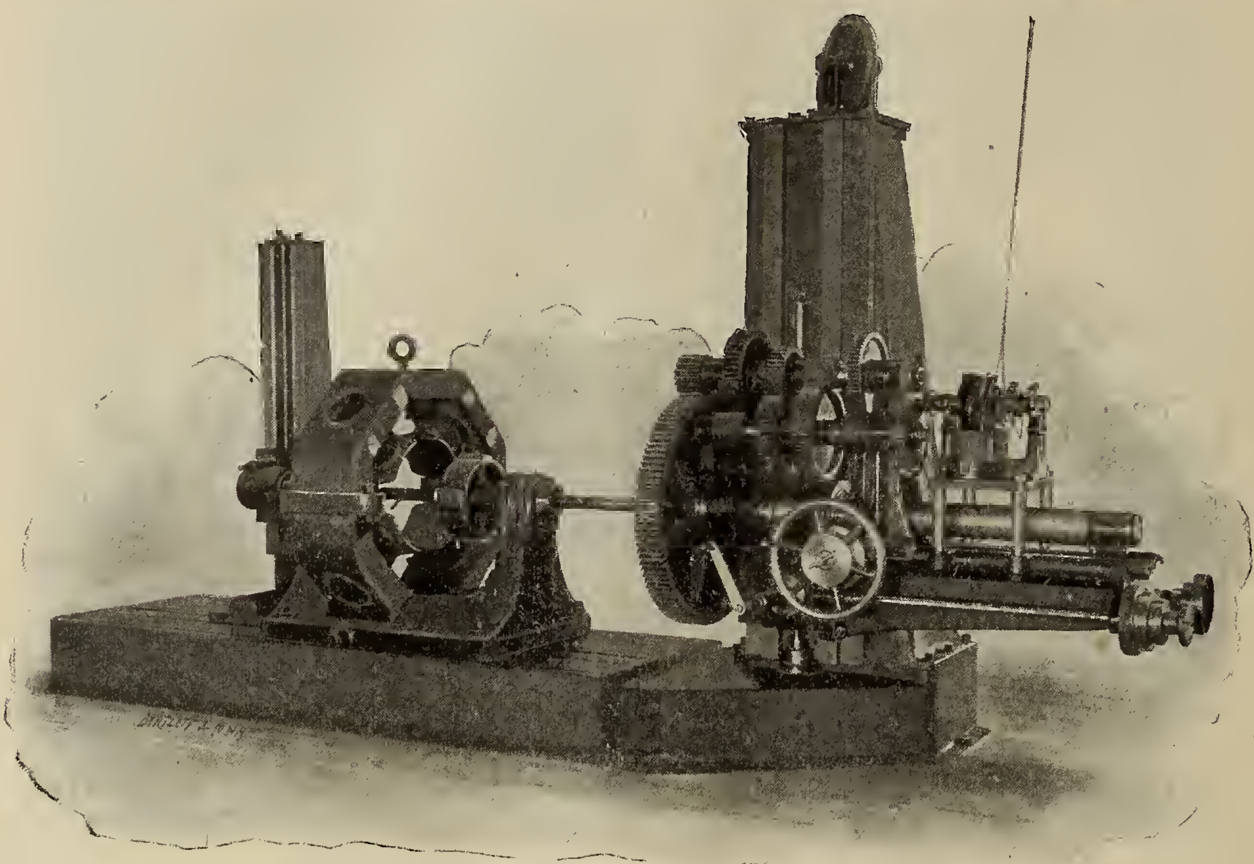
That a manufacturer who was using 500 to 1,000 horse-power in his mills and paying $3 to $5 per ton for coal could save money by utilizing a water power which might be within a mile or two of his mill, transmitting this power electrically to be used in operating his mill, was conceded as not only practical but productive of a great saving in power cost over the use of steam power direct.

That this same manufacturer, did he not have water power available, could well afford to install an electric generating plant to be driven by his engine, taking out,



Size 15 Motor Geared To 15-Ton Sellers Jib Crane.
(CROCKER-WHEELER ELECTRIC CO.)

as far as possible, the belting and shafting in his mill and substituting non-wasteful electrical conductors therefor, attaching an appropriate electric motor to each of his tools or machines where size and conditions made it consistent, and conveniently grouping other tools or machines, each group to be driven by a motor of suitable capacity, has been more difficult to establish as an economic proposition. That the designing and installation of generating and distributing plants of this character for both power and light has become a recognized and a classified industry is evidenced by the thousands of horse-power already installed.



Size 1 Motor Built on Boring Head, Supplying Power to 10-Ton Boring Mill, Speed Changes Obtained by Gearing.
(CROCKER-WHEELER ELECTRIC CO.)

In considering the introduction of electric power, the possibility of a saving in initial power and, therefore, coal, should be given only a passing consideration, for, as a rule, the cost of power is but a small percentage of the total cost of a manufactured article. If, however, a saving can be made in labor or an increased product can be obtained from the same labor, a considerable advantage is at once assured.

With an electric motor directly geared to a tool or machine the condition of increased product is an absolute certainty, for the reason that the slippage of belts is eliminated. This slippage will readily average 10 per cent., and where tools are pushed to their maximum output will sometimes run as high as 20 or 25 per cent. This increase of labor and tool capacity will often warrant a very large investment.

Power Plant, Granite City Steel Company, Granite City, Ill.—Three 100-Kilowatt 230-Volt Dynamos.
(CROCKER-WHEELER ELECTRIC CO.)

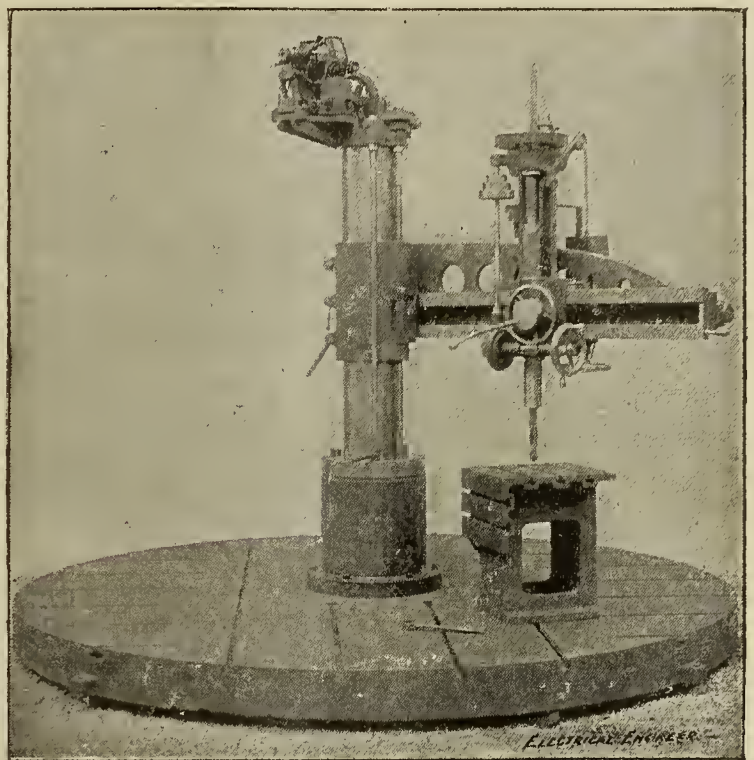
As a matter of course, the use of electric power should not be universally employed, and the C. & W. Co. are always glad to place at the disposal of power users such data and information as they have been able to accumulate, that a proper solution of each proposition may be made.

The flexibility, cleanliness and reliability of an electrical power distribution are also to be commended, and the

fact that lighting and power are both to be derived from the same source, adds further desirable and economical features.

The various illustrations used in connection with this article indicate the ways in which electric power can be applied. In previous articles we have described the many ingenious methods employed for the transmission, generation and utilization of power for specific purposes by the Crocker-Wheeler Electric Co., of Ampere, N. J.

It is, of course, interesting to investigate the many ways (the finer and more scientific applications as well as those involving commercial interests of a large nature) in which people find out how to use generators and motors when they once appreciate their value. There is this to say of those that have grown with the science it has been the result of their persistence that certain practices became general, and it is but natural that on this basis the enjoyment of returns derived from the branches they have cultivated should be theirs. The organization and growth of the Crocker-Wheeler Co. was not the result of a day. It has passed through the battle of competition and remained unscathed. The installation into the public mind of the necessity of using electrical apparatus, that is to say, the creation of a demand for special forms, is due greatly to the efforts of this concern. There is therefore connected with the Crocker-Wheeler Electric Co. a certain historical as well as electrical interest, and its innovations are accepted as the signs of a deep-seated experience and thorough appreciation of the requirements of practice.



Radial Drill Press.—Equipped with C.-W. Size 2 Motor. Diameter of Bed Plate, 11 Feet.
(CROCKER-WHEELER ELECTRIC CO.)

Printing Room Showing Electrically Driven Presses and Absence of Belting and Shafting.
(CROCKER-WHEELER ELECTRIC CO.)

Orion, Ill.—Village trustees contemplate the purchase of defunct creamery plant, for the purpose of converting it into an electric light plant.

THE WAY TO SECURE JAPANESE TRADE.

BY ASSOCIATED TRADE AND INDUSTRIAL PRESS.

Washington, D. C., Feb. 5, 1896.

Hon. James F. Connelly, U. S. Consul at Hiogo, Japan, has forwarded to the state department the following valuable and timely report:

The report encloses a copy of a letter from the National Association of Manufacturers requesting the names of dealers of certain goods, and his answer was as follows:

Your favor of the 24th of October, 1896, in which you desire information as to the Commercial Museum at Osaka, and as to the names of the largest dealers in lamps at that place, has been received.

You will pardon my stating that it would have been better to have forwarded your letter to me through the state department at Washington, and that I shall transmit the following reply to your requests through that channel.

Replying to your first query enclosed herewith you will find a pamphlet issued by the management of the museum regarding which you make inquiry—which very fully answers your questions. I am of the opinion that it would be wise for your association, if the members determine to exhibit their productions, to send a competent person as their agent, who must be able to explain all matters relating to the exhibits and take orders. So far as the exhibiting of novel labor-saving machinery is concerned, I would advise that the agent secure Japanese patent office protection for such machinery before placing the same on exhibition. I am pleased to state that such protection is made possible under the provision of the lately ratified treaty between the Empire of Japan and that of Germany, as, under the favored nation clauses, its advantages extend to our republic.

As to the possibilities for increased trade in American productions with Japan by exhibiting at the Osaka Commercial Museum, I am clearly of the opinion that the sale of American productions will be increased if your association will send such articles as are used generally by the people of the United States that can be produced at prices that will place them in competition with like productions of European markets. It seems to me there is a large and growing market here for the following articles of American and European manufacture, to wit: Iron piping, wire nails and tacks, stoves, gratings, shoes, bicycles, watches, gold and plated jewelry, travelling bags and the different parts used in the construction of the same: all kinds of door, chest and trunk locks, trunk hardware, electrical appliances and machinery of all kinds, and for the different products of cottonseed oil, including common and toilet soap. I name the above productions because my attention is often directed to them, but it should not be taken for granted that they constitute the entire list of those that can be marketed here; and in this connection I repeat that all articles used generally by the consumers of the United States can be sold to the consumers of Japan.

As to the most practical and least expensive method which the members of your association can employ in making their exhibits and securing profitable results therefrom, I would suggest that the producers who desire to enter the commercial field of Japan agree upon an agent who, after posting himself thoroughly as to detail of the productions he is to represent, shall come to Japan, secure the required space, have his samples sent to him, and, after displaying them, proceed to do business in precisely the same manner as he would in the home market. If the agent does not understand the Japanese language he can employ a thoroughly equipped interpreter (who are known here as "Bantos") at from 75 to 100 yen per month, which would be equivalent to about $40 United States currency.

As to your query about lamp dealers in Osaka I submit the following names as those of the principal dealers:

Waichi Araki, Minami Kiuhojimachi, Kitayi iru, Shinsai Bashidori, Osaka, Japan.

Shotaro Komai, Minami Houmachi, Shichome, Higashi, Ku, Osaka, Japan; but you will pardon me for suggesting that should the members of your association determine to send an agent to Japan, as hereinbefore advised, it would be wise to leave the lamp business to him.

In conclusion permit me to express my thanks for your reference to my reports and to enclose for your consideration a copy of my latest report to the department of state, comparing the foreign trade of the Empire of Japan and of Osaka and Hiogo (Kobe) for the first six months of 1896 with the corresponding period of 1895.

Hon. Alfred C. Johnson, U. S. Consul at Stuttgart, has forwarded to the department of state the following report:

Mr. Henry Weissenberger, of Cannstatt, requests me to call the attention of American manufacturers and shippers to the fact that on July 4, next, he proposes to open in this city a museum for the exhibition of American products.

Being convinced that such a measure might be of material benefit to American exporters, I herewith give notice of his undertakings.

Mr. Weissenburger assures me that as soon as he had 100 American houses to represent he will give his entire time to the undertaking. Mr. Weissenburger, while personally unknown by me, is well-spoken of, and yet, while assuring him of my interest in his plan, I have informed him that he must be prepared to give the best of references as to the American business world before he can expect business houses to enter heartily into his undertaking. All that I know of Mr. Weissenburger is favorable; at the same time I am not willing to take any personal liability in recommending American firms to enter into negotiations with him.

EDISON'S IRON MILLS.

According to the "Industrial World" the Pittsburgh "Dispatch" gives a graphic account of the new Edison iron works, at Edison, N. J., in the heart of a wild mountain region. The first thing noticed is a frightful roar that comes from some of the buildings. From a little wooden chute which juts out from a big wooden structure that resembles a grain elevator more than anything else there drops each day thousands of little black objects. They are the size of and shape of butter cakes. They are little cakes of Bessemer, baked hard as flint and roll into cars ready for transportation to the blast furnaces in Pennsylvania. Those little black cakes mark the greatest achievement in the career of Thomas A. Edison. He worked on the problem for years. Now his plant covers eleven acres, and is the biggest mill in the world. It has cost in round figures, $2,000,000. He has a stretch of mountains thirty-three miles long as a basis of supply. The mills take a boulder weighing five tons, and chew it up faster than a healthy small boy could eat a peanut. He employes over 700 magnets to separate the ore from the rock. The whole process is done automatically, at the rate of 5,000 tons a day, and the finished product is put into cars ready to be shipped at a cost of 78 cents a ton. It costs almost $3 a ton to get the richest ore in Pennsylvania. The mills pay 15 per cent. on the capital invested. He began to work on the problem ten years ago, and at odd moments constructed a small model which satisfied him the plan was feasible. While everybody laughed at him, he went on. The first thing to do was to find the ore. He started out with magnetic needles and was out six weeks; visited the mountains in New Jersey, and at last found some rock which looked like gneiss, common in the state of New York. He found stretches of that gneiss four and a half miles long and

1,600 feet wide, and much of it deflected the magnetic needles. At the mill there is one ledge 400 feet wide and one mile long, and another that is two miles long and 200 feet wide, and these bodies contain 28 per cent. of oxide of iron.

The works are something tremendous. The rock is crushed. The first mill breaks the rock into particles eighteen inches in diameter; the second to eight inches; the third to three and one-half inches; the fourth to two inches, and the fifth to one-half smaller. From the last mill it passes to a big tower, where it strikes one hot plate after another in descending, and is dried at the rate of five tons a minute. From the dryer it passes into a stock house, where it is kept until used. There are three sets of magnets; seventy-four in the first, 420 in the second, and 320 more in the last. The magnets are about four feet long and the ore in its journeyings has to pass a mile of face magnets, in the course of which every particle of the iron is saved and every particle of the base thrown away.

EMIL DU BOIS-REYMOND.

Emil du Bois-Reymond, the eminent physiologist and philosopher, died in Berlin on December 26, 1896, at the age of 78. He was the last of those four bright stars that illuminated the horizon of natural sciences for more than half a century. They are all gone now. Brücke died first (1892); then Helmholtz (1894) then Carl Ludwig; and now du Bois-Reymond, last but not least, has passed away. These four eminent men who made everlasting marks in science have been long-life friends. All four were pupils of that grand master Johannes Müller. All four started out on their phenomenal scientific careers in the beginning of the forties and, though each one worked in a different line of research, they all had one object in common, which was paramount to them, and that was the liberation of the biological sciences from the deadening grasp of the obscure natural philosophy of those days, and the building up of physiology on a scientific rational basis. In combating the paralyzing idea of a "vital force," none was as energetic, none as perseverant as du Bois-Reymond. Only recently the old warrior in service of rational science again entered the arena to fight the old enemy in disguise, the "neovitalism" of a Bunge, a Rindfleish and others. Du Bois-Reymond and the other great physiologists are no more, and there is at present no one to fill their places. Who will protect physiology against the onward course of these new "vital forces."

AMERICAN MANUFACTURERS' AND EXPORTERS' EXCURSION.

Gentlemen: You are hereby invited to take part in an excursion to Denmark and Sweden, from New York, in May or June this year.

The object of this excursion is for American manufacturers and exporters to investigate for themselves the facilities of opening trade with the northern part of Europe through the free port of Copenhagen.

A stop of ten days will be made in Copenhagen; thence the excursion will proceed to the industrial exhibition in Stockholm, Sweden.

Another stop of ten days will be made there, which which will enable the participants to examine the industries of the Scandinavian countries, and thereby judge for themselves to what extent American products could be introduced in these countries.

The whole trip can be made in two months, and the ordinary expenses will not exceed two hundred and ten dollars, including first cabin on steamer from New York to Copenhagen and return (Thingvalla Line); first-class railroad to Stockholm and back; ten days' stay at first-class hotel (rooms only), both in Copenhagen and Stockholm.

For further information and illustrated pamphlet relating to the free port of Copenhagen, apply to

George Kirkegaard, Manager,
28 State Street, New York, N. Y.

THE MODERN POWER HOUSE.

BY RICHARD M'CULLOCH.

(Begun in January 23d, 1897, Issue.)

BUILDING.

The main points which should be borne in mind in the design of the building are that it should be light, airy, compact and fireproof. The shape and size of the building will be largely governed by local conditions, but there is one general arrangement which has been adopted in a number of the most recent power houses. This will be discussed later. There is no reason why anything combustible should enter into the construction of a power house. The walls may be brick, the roof of slate, tile or iron, and the floors of concrete or iron. This method of construction not only increases security against fire, but it obviates the necessity of carrying insurance, the saving of which will in a few years pay the extra first cost. The building should be substantially constructed, but unless the location is on an important street there is no necessity of going to great expense to render the building ornamental, especially as all money which can be spared for this purpose may be far better invested in machinery to put inside the building. In erecting a building for use as a power house it is advisable to decide first on the style, size and arrangement of the machinery so that no part of the building will interfere with the proper repairs, renewals and inspection of the apparatus. This may seem unnecessary advice, but it is a very common oversight for railroad companies first to decide on the style of building they wish, then let the contract for the erection of the power house building, and then find themselves hampered in the use of some particularly desirable form of apparatus by the shape or contracted area of their buildings.

As by far the greater number of the modern railway power stations are operated by steam-power, steam alone will be considered in this article. For convenience in discussion the apparatus in a power station may be divided in three classes: (1) The steam generating part, consisting of the boilers, pipes and all their accessories, such as coal and ash conveyors, mechanical stokers, stacks, economizers, feed-water heaters, pumps, etc. (2) The steam consuming part, consisting of the engines, steam separators, oiling devices, condensers, etc. (3) The electric part, consisting of the dynamos, cables, switchboard, electrical instruments, etc. The division between the first and second parts is more easy and more marked, as it is usually accentuated in the power house itself by means of a brick wall.

STEAM GENERATING APPARATUS.

Beginning with what we have called the first part, we start with the choice of fuel. This is largely a matter of location. In a general way the proper fuel to use is that which will evaporate the greatest quantity of water per dollar's-worth of fuel. It does not pay to burn too poor a quality of fuel, however, because slack containing a great quantity of ash and sulphur will cake and clinker on the grate bars, make a great deal of work for the firemen, refuse to be forced when necessary and make much ash to be removed. On the other hand it will not do to make all arrangements for using a very expensive fuel, as a very little wasted in times when the furnaces must be rushed will make a great difference in the cost of operation. As

an expensive fuel usually means one which is brought from a great distance, any furnace prepared for burning this would operate under unfavorable conditions if the supply is cut short by strikes or railroad blockades. Where the conditions are favorable for the use of oil it makes an ideal fuel, requiring no handling, making no smoke or ashes, and allowing the fire to be regulated with the utmost nicety. Buckwheat anthracite coal is used largely by power houses in the eastern cities. It is of high calorific value, clean, making no smoke and little ash, and capable of being readily handled in coal conveyors and mechanical stokers. In the western cities soft, bituminous coal is used by force of necessity. This brings with it the troubles of ash, clinker and dirt, and in the city renders necessary some form of smoke consumer. As has been stated, it usually happens that the choice of fuel is a matter of location, but in cities where several competing grades of coal come to market, it would probably pay to have expert tests made to determine what grade of coal or what mixture is most economical for the work.

It is hardly within the limited scope of this article to discuss the numerous forms of coal and ash conveyors which have been put in use. Several large companies make a specialty of this form of machinery and special designs are developed for each power house. We may say in a general way that in power houses handling large quantities of coal, where the coal is all delivered at the same place as by rail or boat, the installation of coal and ash handling machinery will pay. Where coal is delivered in small quantities and where it is delivered in wagons and may be dumped at any part of the boiler room, the reverse may be said. The advantage of this form of apparatus is its saving in labor, and its disadvantages are its great first cost, its expensive maintenance and the fact that it is desirable for the best service that the coal should be fairly uniform in size, which is a requirement not always easily fulfilled.

In the East the use of mechanical stokers has grown to such an extent that no large power house is considered complete without them. In most of the western cities, however, and especially here in St. Louis, the mechanical stoker has not been a success. This difference in results may be attributed to the difference in the fuels used. The buckwheat coal of Brooklyn and Philadelphia feeds evenly on the stoker and causes no trouble by cementing the grate bars together by clinkers. With the soft, fragile, bituminous coal, however, clinkers soon form on the grate bars, and very often the fire must be almost completely destroyed to remove them. No mechanical stoker will bear crowding to any great extent, and any power house using them must be supplied with a greater capacity of boilers than one where hand firing is in practice. By reason of the fact that the coal is introduced gradually into the hottest part of the fire and the volatile matter slowly driven off, the mechanical stoker is a partial smoke consumer. With the exception of this there is no advantage in the use of mechanical stokers, except the labor saved, as the great efficiency which was formerly claimed for them has never been proved in actual practice.

(To be continued.)

A WATER-POWER AND COMPRESSED AIR TRANSMISSION PLANT, FOR THE NORTH STAR MINING CO., GRASS VALLEY, CAL.

BY ARTHUR DE WINT FOOTE.

Trans. Am. Soc. C. E. Vol. XXII, 1896.

The writer states that the price of water used was one cent per 1,000 gallons taken from old placer mining canals, the water being conveyed to the lowest convenient point by a 20-inch rivetted steel pipe, the total distance being nearly four miles, with a head of 735 feet, or a static pressure of 335 pounds per square inch.

The consideration of transmission from Pelton wheels to pumps was between electricity and compressed air, and was decided in favor of the latter, on account of less first cost of plant, greater economy of power and less liability of accident, but chiefly because almost absolute security against stoppage could be obtained by having a set of boilers on hand, as the air motors could be driven by steam by changing a few valves.

To obtain a rim velocity of Pelton wheel one-half of spouting velocity, and not to work compressors more than 60 or 70 revolutions per minute would require a wheel 30 feet diameter. The Pelton Water Wheel Company did not care to attempt such a large wheel. A compromise was effected by building a wheel 18 feet, six inches diameter, with a guaranteed efficiency, at full load, of 85 per cent., and an average efficiency from one-half load to full load of 75 per cent., and to so govern the wheel as to not give more than 120 revolutions per minute, or to not raise the air pressure above 105 pounds in any case. The ordinary pressure was 90 pounds, and the air being used in hoisting engine, pumps, drills, blacksmith's forge, etc.

The Pelton wheel has four sets of nozzles for one-quarter, one-half, three-quarters and full loads, and for intermediate loads hoods are used, efficiencies of over 90 per cent. were obtained in tests at each one-quarter load, these efficiencies becoming slightly less at intermediate stages, where the hoods were brought into use to throttle the supply. A novel feature of the air compressors is the inter-cooler. The air compressors work in duplicate, the air leaving the first compressor at a temperature of 200 degrees F. passes through a nest of 49 soft copper pipes one inch diameer, 18 feet long. The water from the Pelton wheel dashes against these pipes, and reduces the temperature of the air to 60 degrees F. before it enters the second compressor.

The air is led to the mines by 5¾ inches screwed pipe, and is there reheated to from 350 degrees F. to 400 degrees F. before being used; one-half cord of pine wood per day is needed to heat 700 cubic feet of air per minute.

The exhausted air from air motors is used for heating and for drying clothes.

The air conducted to the pumps in the mines arises at 275 degrees F. and exhausts at 60 degrees F., giving cool, fresh air to the man.

The following efficiencies were obtained by tests made by Mr. Rix:—

Efficiency of wheels	93 p. c.
Efficiency of compression and transmission of air, including reheating	78½ p. c.
Efficiency reckoned from water delivered to air motors, including cost of reheating	73 p. c.
Efficiency from water delivered to work done by air engines	61½ p. c.

Electricity was not needed for lighting or tramways, or otherwise the comparison would not have been so favorable to compressed air. C. B. S.

New York, Feb. 3, 1897.

Dear Sirs:—Can you give me any information concerning galvanic action in boilers.

A Subscriber.

(A.)—Differences of temperature may create galvanic action. The so-called galvanic action is frequently merely corrosion of a chemical nature, or possibly due to "pitting" from watery impact.

The Electrical Age.

ESTABLISHED 1883.

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NEW YORK, FEBRUARY 13, 1897.

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ELECTRIC LIGHT CORPORATIONS.

Every age has its ambitions. The ancient days of remote antiquity—the days of the Rameses, the Pharaohs of Egypt are marked by the construction of vast pyramids. Each great ruler built his own monolith, which remain to this day intact, as a time-worn monument of human ambition.

In large cities the monuments built are those of wealth, and in the mad rush of masons eager to build only those that rear these lofty edifices acquire the joy of public fame—the rest compose a worshipful audience.

It has been thought that certain fields in electrical engineering offered broad highways to success. Electric lighting represented the means by which great profits could be accumulated and enormous dividends disbursed. These fits of enthusiasm are passing away. The more prosaic side of business life has ultimately created a spirit of greater patience and steadied the unbridled aspirations of money seekers. With a realization of the fact that electric lighting, like other fields of work, must be slowly built up in order to be successful and that a great expense attaches itself to the installation and operation of a plant, many a financier's expectations cooled down.

The following report published in the Brooklyn Citizen of the Edison Illuminating Co., of Brooklyn, is of a most interesting nature:

The Edison Electric Illuminating Company, of Brooklyn, reports for the year ended December 31, 1896, gross earnings of $810,266, an increase of $189,117; expenses of $451,266; increase, $110,558; net earnings of $359,000; increase, $78,558, and surplus of $59,412; increase, $10,000.

The report shows the gradual increase that leads to financial success, and indicates a condition of true prosperity.

A New York electrician has devised a scheme for the indefinite preservation of eggs. For years the only successful method of accomplishing this result has been to submerge the hen fruit in lime water long enough to close up the pores in the shell, and kill any germs which might be lurking about, reports the Journal. With this treatment it has been possible to preserve eggs in such a state as to permit their use three or four months after the submersion. But at the expiration of this time, while the eggs are in a condition to be used by confectioners and bakers, they have lost the delicacy and freshness which make them appetizing for the matutinal meal.

However, if the electrician's scheme proves to be a success eggs can be preserved for an indefinite period in as eatable a condition as when first laid. The treatment proposed involves the placing of the eggs in a vacuum chamber. It is a well-known fact that the shell is not absolutely air-tight, and there is always more or less air inside the outer covering, which hastens its decay. Putting them in the vacuum chamber will have the effect of drawing the air from the interior. They will then be painted with a composition which will render the shells air-tight.

After this they will be packed in barrels of water and an electric current will be introduced sufficient in strength to destroy any germ life that may be present. If the scheme is successful it will mean a revolution in the price of eggs in the winter.—The Boston Journal.

The great Anaconda mine is a source of wonderful wealth. Tons of copper are daily refined and turned out for commercial use with an undiminished regularity. While this particular mine, equipped in every possible manner with electric appliances, stands forth unexcelled as an example of scientific applications, many smaller mine owners have held back until recently, being in doubt as to the reliability and cheapness of this power in mining. But compressed air machines are becoming obsolete in this great field of work, and according to the report of the State Inspector of Mines, the best mining practise calls for the installation of electrical machinery wherever possibie.

The following extract contains the eventual history of not only England but the other countries of the earth.

The remarks taken from the "River Falls, Wis., Times," have the following drift: "That the commercial supremacy of the British empire was initiated by our being the first to employ, on a large scale, the coal at our disposal. If coal ceased to be necessary for our industries he doubted whether the empire would maintain its commercial supremacy. In the falls of Niagara there was a waste of more power than could be derived from all the coal that could be raised throughout the world, and there were many other falls than Niagara. It would be the work of the engineer to utilize those falls, and then we should either have to live on our accumulations or we would have to fight. The commercial supremacy of Great Britain would have gone."

It seems that America at least will possess those funds of charity from which will be dispensed at her will national prosperity to less fortunate nations. The great African falls, the torrid heat of Sahara, will give a surplus of power to England when her mines are exhausted. America and England may be the last to require aid and the first to extend it.

MULTIPLE TELEGRAPHY.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

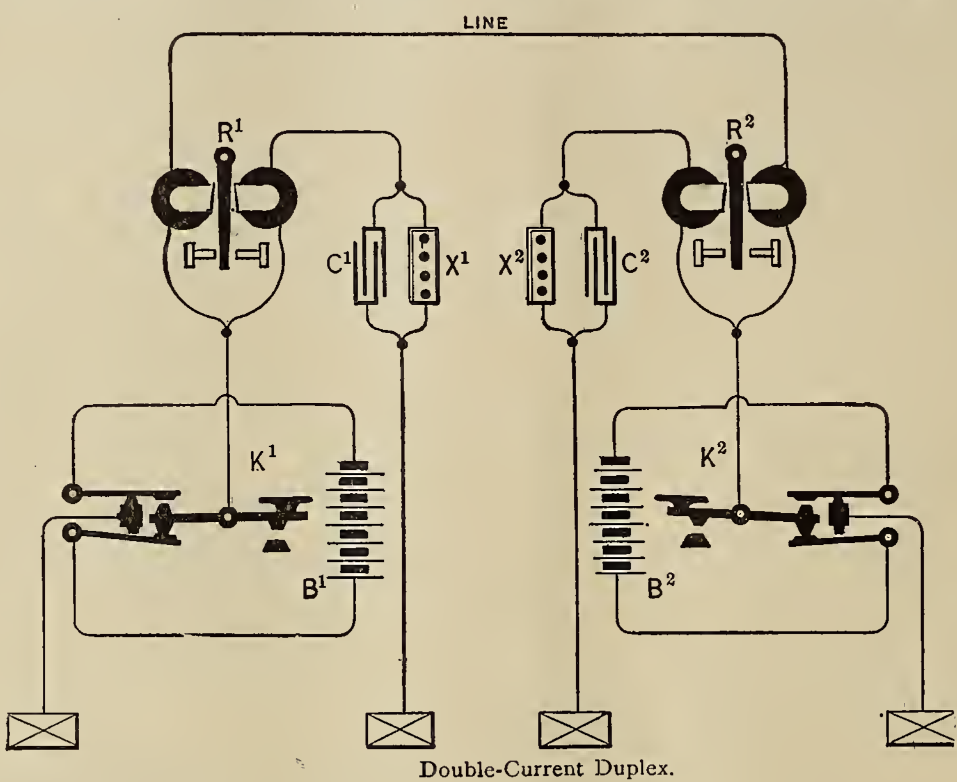
The Quadruplex.—The meaning of a quadruplex system of telegraphy may be traced to a combination of two systems, the single and double-current duplex systems.

Double-Current Duplex.—The explanation of the quadruplex necessarily involves the analysis of the double current duplex upon the basis of which a four-message system on one line becomes possible. In double current duplex work a double-action key is employed at each end of the line. When either is depressed they reverse the direction of the current without breaking the circuit.

Polar Relays.—The use of the polar relay is found in this method of telegraphing, and it serves the following purpose: When current is sent into a polar relay, the relay is only effective in opening or closing the circuit when the current flows in a given direction. A polar relay is an electromagnet whose armature is a magnetized piece of steel. The steel, having poles, is attracted either one way or the other according to the polarity of the electromagnet, the polarity of which is determined by the direction of the current circulating in its coils. A polar relay therefore possesses a polarized armature; an armature with poles.

Polar relay differentially wound.—The relay, if differentially wound, will leave the armature unaffected even with a current circulating, at the *same* end as that at which the key is depressed. This current at the distant end is received by the station at that point, and operates the relay there. When the key is depressed a current issues outward, a positive current; when it is raised a current enters, a negative current. The direction of the current sent out therefore is the only means of affecting the polar relay at the other end, and this system may be distinguished as one dependent upon direction and not volume as in the last single-current duplex system. While one end is sending a message the other may be also doing likewise; both signals are therefore sent and received at the same time at each end respectively.

The System.—The artificial line is supplied in this as in the single-current system, and the main point to recollect is the fact that it involves the use of a double key at each end, which reverses the current, and a differentially wound polar relay sensitive to such changes.

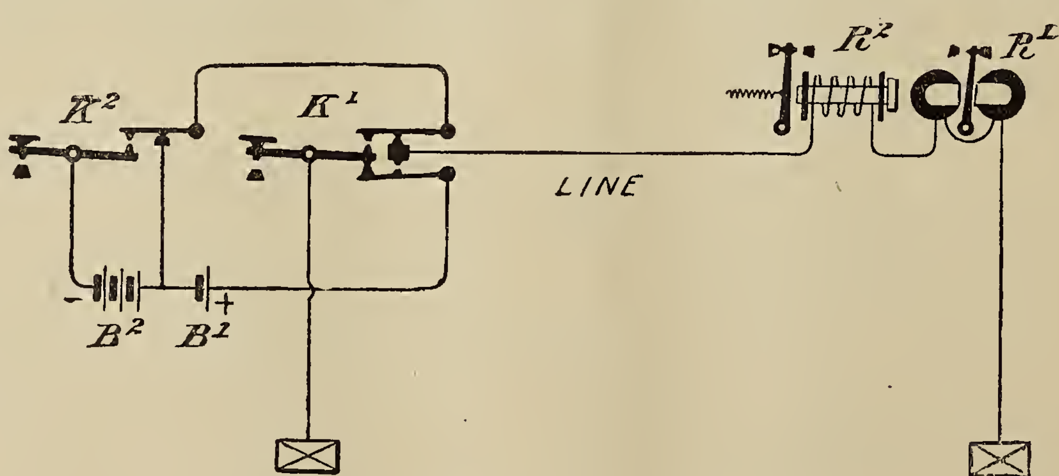


Double-Current Duplex.

Double-Current Duplex.

Quadruplex Telegraphy.—For the quadruplex transmission of signals a double set of keys are used. One similar to the last described performs the function of reversing the current. The other merely controls the current of greatest strength.

Its Principle.—Perhaps the fact has been already noted that in single-current duplex telegraphy, the relay is affected by the changes in the *strength* of the current, and in double-current duplex entirely by the *direction* of the current. It seems evident that upon this basis a double system could be constructed, such that either the strength of current affected one relay or the direction of the current the other; and with this combination, currents could be sent and received depending upon their quality to the extent of four at one time.



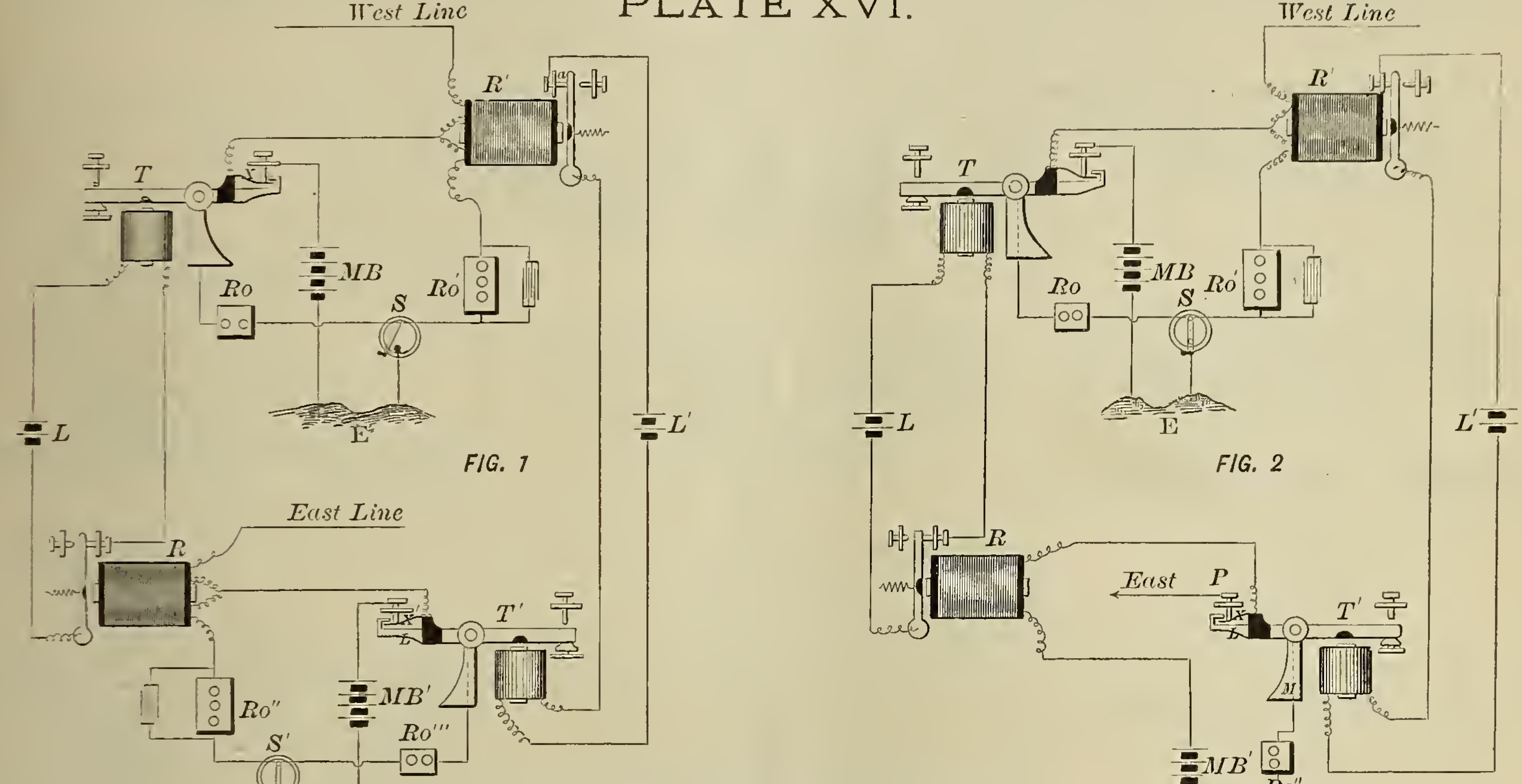
Basis of Quadruplex.—Duplex Telegraphy.

Polar relay and neutral relay in series.—By having both the polar and neutral relays in series, a given direction of current will only affect the polar and a given strength the

neutral relay. Two keys are therefore used controlling each condition.

The reversed currents moving the polar relay are too weak to operate the neutral relay, therefore it is exempt from that influence, being entirely under the control of the stronger current sent forth by the other key.

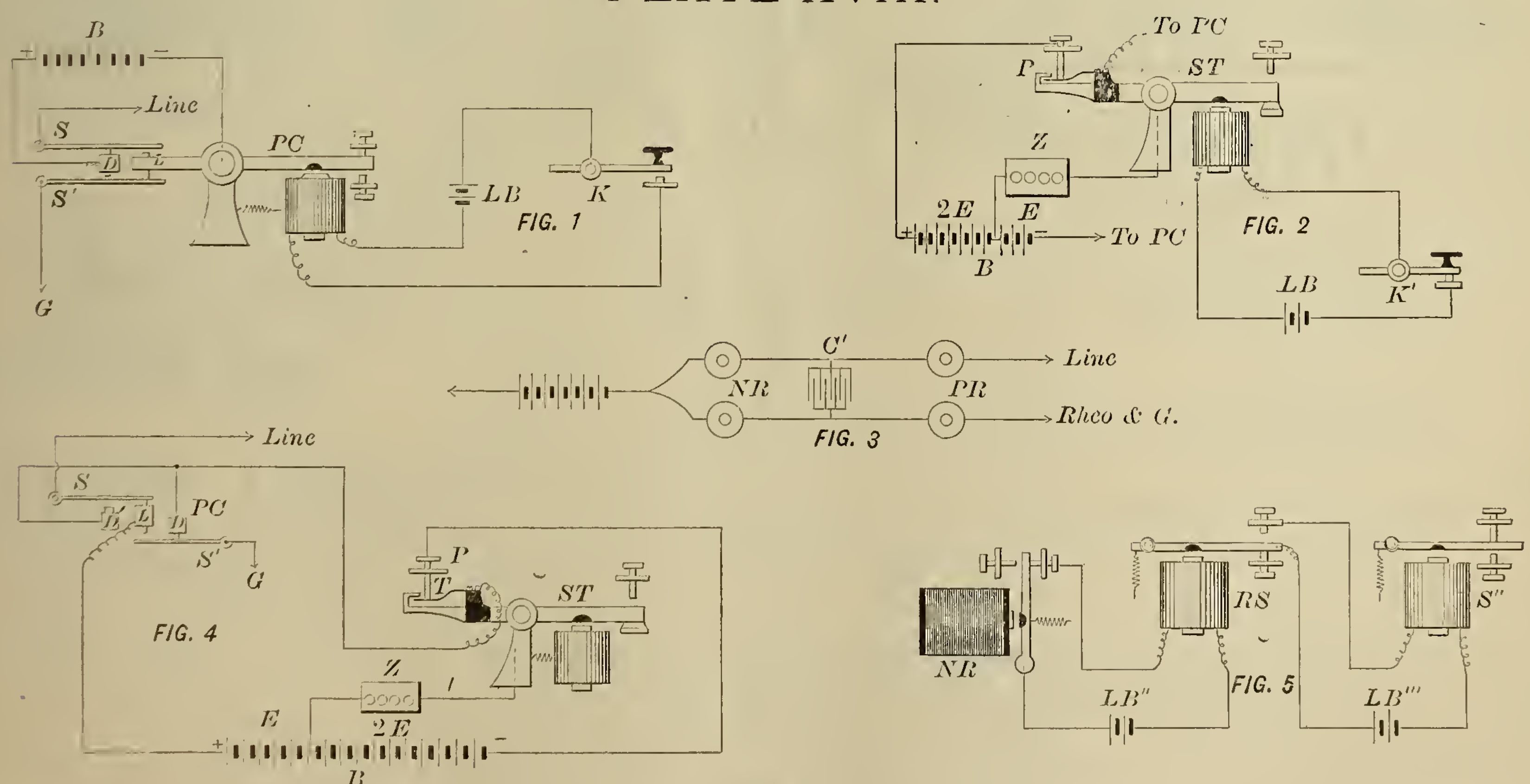
PLATE XVI.



DUPLEX ARRANGEMENTS FOR WORKING INTO SINGLE SETS.

"The use of electric power in mining is coming into extensive use in Ohio, and is displacing compressed air machines. In 1895 eighty-two air and eighty-two electrical machines were in use, while in 1894 the air machines were one hundred and twelve and the electric machines fifty-nine. The total amount of coal mined in the state

PLATE XVIII.



DETAILS OF QUADRUPLEX APPARATUS.

in 1895 was 13,683,879 tons, of which 3,120,456 tons were mined by machinery, a gain over 1894 of 546,990 tons."

In copper works the electrolysis of copper supplies enough silver to pay for the expense of refining it. The copper is clear gain to the owner. In coal mining a great deal of waste occurs which might be prevented by the use of superior machinery. The United States Geological Survey, in reviewing the mining products of the United States, show in their report an increase in copper of from 265,115,133 pounds in 1890 to 381,106,863 pounds in 1895, traceable to the superior facilities offered by the use of electricity. The call for more copper and the ability to produce it rapidly are two different things. Reference is merely made to the increased production of over 100,000,000 pounds in five years. The losses that have occurred, due to power wasting machinery and poor methods, seem to belong now to the earlier days. There is every evidence that mining engineers have found the use of electric power an essential part of their education, to know which means success.

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Trevert's Electric Railway Engineering,	2.00

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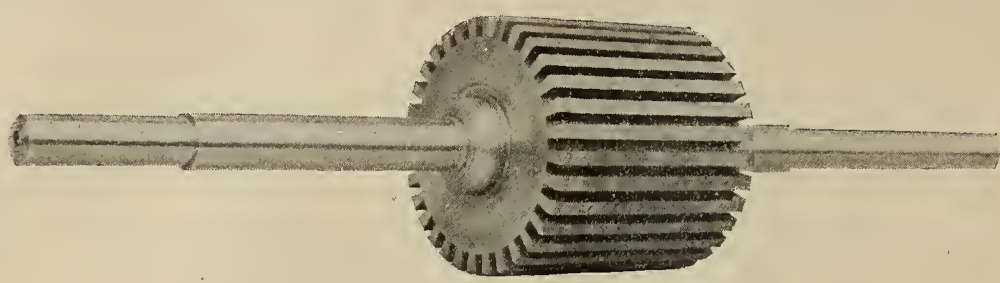
ELECTRICAL AGE PUBLISHING CO., World Building, New York.

"ECK" DYNAMOS AND MOTORS.

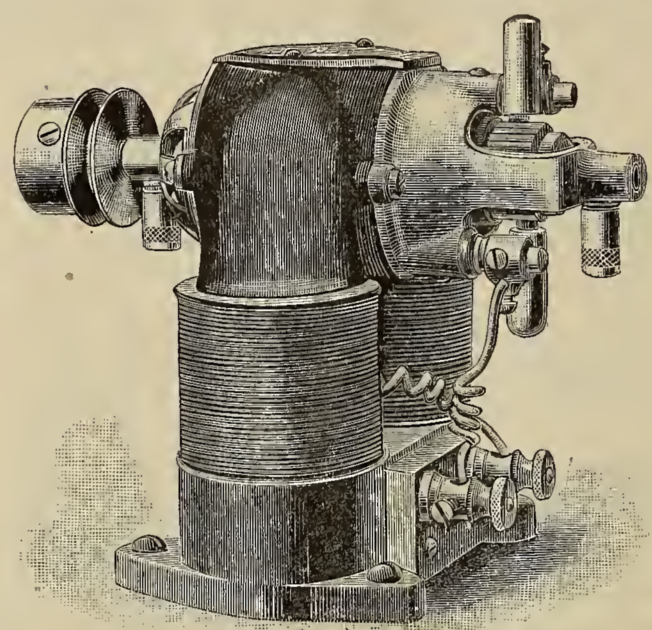
In reading the circular of C. A. Eck, the modesty of his first remarks appeal strongly to the finer sentiments; he says "I shall endeavor to maintain a high standard some of its parts. In line with the design of the completed machine we find sizes made ranging from $\frac{3}{10}$ to $8\frac{4}{10}$ kilowatts capacity. The dynamos and motors turned out in Mr. Eck's shop have been made with self-oiling bearings (that once in a fortnight require attention), hav-



Slotted Drum "Eck" Armature Core.

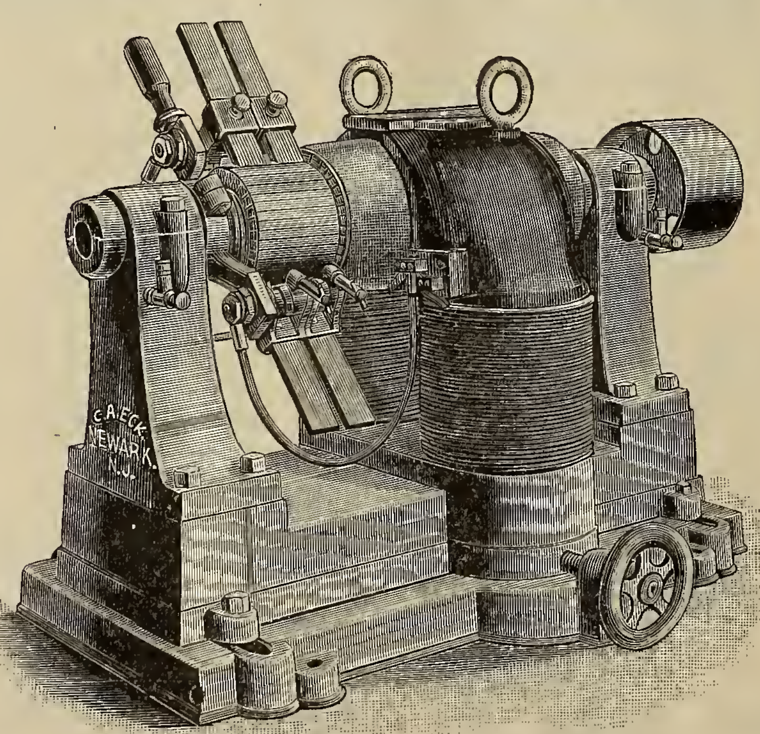
of quality in all the articles I make, and hope to receive the approval and confidence of the trade." There is much in the attitude of manufacturers that affects the rapidity of their sales; and to the outer public the demeanor assumed inevitably produces strong effect. A ing phosphor bronze bushings which rest in a spherical seat, giving perfect alignment.

The armature is slotted drum type, built up of well laminated iron. Each slot is insulated with mica, and when wound, has no bulging strands above its surface.



Type of "Eck" Motors 1-8 and 1-6 H. P. for 110 and 120 Volts.

hue-and-cry over a bad article that is represented as good, kills the future of it, and although advertising may influence the sales the public must become personally acquainted with its good qualities before it is looked upon with distinct favor. Mr. Eck has therefore made no loud Each slot is likewise covered with a strip of insulation (fibre or mica) before binding takes place. The great radiating surface of the armature enables it to stand a heavy overload without injury, and its excellent construction mechanically and electrically places it among the



Standard Type "Eck" Dynamos; Sizes, .3 to 8.4 K. W.

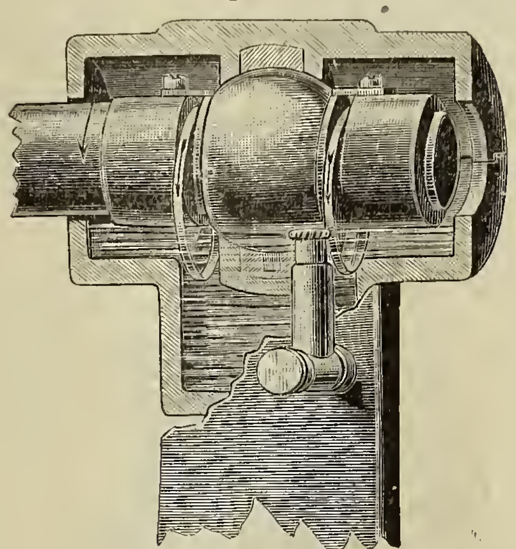
assumptions in introducing his machinery to the trade knowing that their appreciation of it will spread outward in widening circles of good opinion.

The illustrations represent the completed machine and best in the field.

The dynamos are supplied with brush holders of two styles, either with brushes pressing at 45 degrees or pressing radially upon the surface of the commutator. The

simplicity of the brush holder would appeal to the observant eye at once, as well as other details in connection with the construction of these machines.

The illustration of the smaller machine represents the $\frac{1}{8}$ and $\frac{1}{6}$-H. P. types for 110 or 120 volts. In general it has received the same close attention as the larger machines and in serviceability cannot be excelled. Self-feeding carbon brushes, self-oiling bearings, wrought-iron cores and a slow speed make it a most desirable machine. Many excellent points, that for lack of space cannot be mentioned, show the care bestowed by Mr. Eck upon the design and construction of his apparatus. By corresponding with the able sales agents, Messrs. Goldmark & Wallace, 29 Chambers street, New York, particulars and prices can be obtained.



Self-Oiling Bearing on "Eck" Dynamo.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—CURRENT DENSITY IN CONDUCTORS.

Albany, Feb. 5, 1897.

Electrical Age.

Dear Sirs:—Your Inquiry Column has offered so many advantages to me lately that I refer to it for all the information I require. Can you let me know how much current is required for the different sizes of wire used, or in what way it is possible to decide upon the proper size in any case?

Yours very truly,
William Dunton.

(A.)—The amount of current a wire will carry depends upon its diameter, that is, its cross-section. The thicker a wire is, the more current it will take without heating. About 1,000 amperes per square inch is the usual allowance, but the current density is best determined by the radiating surface of the wire and not represented by any specific value. A given size of flexible cord and its equivalent in a solid conductor will be possessed of different current capacities, the flexible carrying more current without heating. Coils may be safely wound on the basis of 1,000 circular mils per ampere. Armatures about 500 circular mils per ampere.

(Q.)—OIL INSULATION.

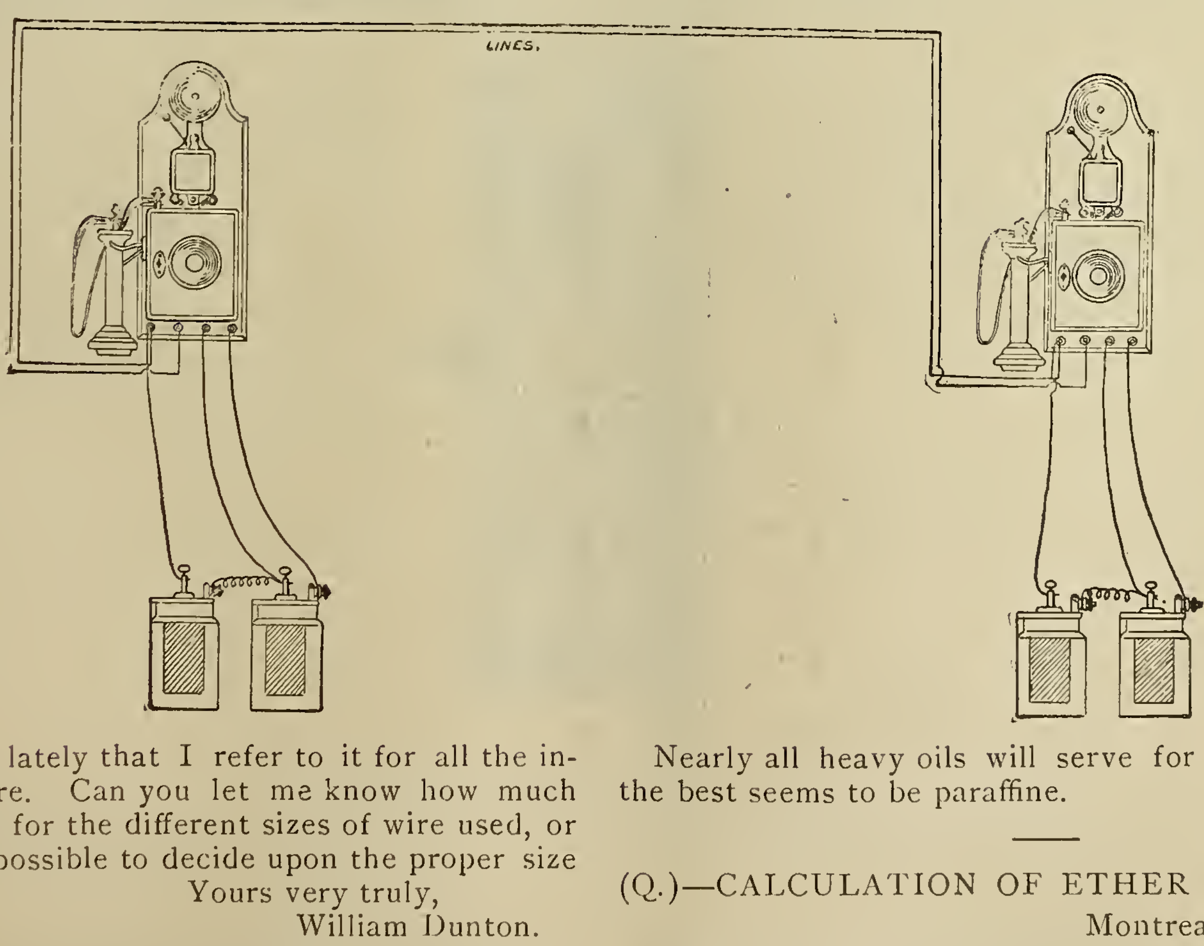
Key West, Fla., Feb. 2, 1897.

Electrical Age Pub. Co.

Dear Sirs:—Can you recommend some good insulation for high potentials; which is preferable, oil or paraffine? There seems to be something which will insulate a pressure of this kind. By recommending it you will oblige,

Yours truly,
Joshua Hein.

(A.)—For alternating currents of high potential paraffine oil is a good insulator. Paraffine itself is very good, but is apt to dissolve, due to the effects of the lengthened temperature of the coil.



Nearly all heavy oils will serve for this purpose, but the best seems to be paraffine.

(Q.)—CALCULATION OF ETHER WAVES.

Montreal, Feb. 5, 1897.

Dear Editor:—Kindly supply me with the following information: What is the equation of discharge of a con-

denser? If the resistance is small I have heard that the discharge is oscillatory; how can I calculate the number of oscillations?

What purpose does it serve in a spark coil?

Yours respectfully,

Ernest Du Bois.

(A.)—The equation of discharge of a condenser with a negligible resistance is

$$L \frac{d_2 q}{d t^2} + \frac{q}{C} = O$$

t = time,
C = capacity of condenser,
q = current,
L = self-induction.

The time of a complete oscillation is calculated by the formula

$$t = 2 \pi \sqrt{L C.}$$

The number per second can be obtained from this formula. Leyden jars, according to Fleming, discharged through short circuits give rise to millions of oscillations per second.

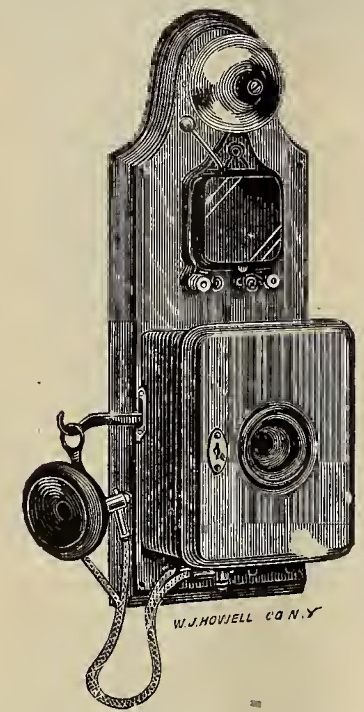
In a spark coil a condenser serves the purpose of raising the potential of the secondary.

It acts at the break in this wise: Returning the energy it has stored to the primary circuit in the form of a reversed current and increasing the total charge of induction.

The best capacity for the condenser is determined by trial.

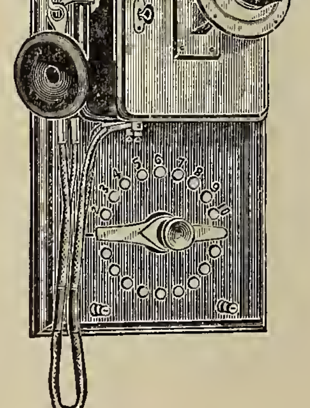
DE VEAU & CO.

The many grades of apparatus used in connection with telephonic systems have stimulated competing manufacturers in the production of some remarkably ingenious and practical devices. The accompanying illustrations show appliances used in connection with an intercommunicating system diagram of telephone connections and an office and factory telephone supplied with either a Blake or coal grain transmitter manufactured by De Veau & Co., 32-34 Frankfort street, New York. A visit to the factory and salesrooms of this enterprising and progressive concern will enable the visitor to gain a clear idea of the details covered and care required in the construction of telephonic apparatus.



Office and Factory Telephone.

The combination sets sold by De Veau & Co. consists of a coal grain transmitter, hook, receiver, cord, bell and switch well-mounted on a backboard. This extremely useful piece of apparatus requires no switchboard, possessing its own. The switch seen below establishes communication by turning it to the desired number; the greatest


Telephone Set for Inter-communicating System.

number of points supplied being equal to 24 for metallic circuits only.

The office and factory telephone can be used as a general telephone, and is useful for either ground or metallic circuits. Being well-constructed, nicely finished and very serviceable, it will brook the greatest competition. The diagram represents the connections required for this particular style of 'phone. Many valuable suggestions may be found in De Veau & Co.'s catalogue as well as other interesting types of telephonic apparatus. They are prepared to supply complete equipments, and possess the experience and skill required to make their installations a pronounced success.

Advantages of the Combination Wire.—With an iron wire telephonic conversation cannot be carried on at a distance exceeding 250 miles; but with a compound wire, consisting of a steel core surrounded by copper, it can be carried on very well between New York and Chicago, which are rather more than 1,000 miles apart.

POSSIBLE CONTRACTS.

Valley Junction, Iowa.—An electric light plant is in contemplation.

Worth Wales, Pa.—Muir & Hall, of Philadelphia, will operate an electric plant in this town.

Finn's Point, N. J.—An electric light plant will be established.

Maxton, N. C.—An electric light plant is to be established.

Cambridge, Mass.—An electric light plant is to be installed in the City Hall, and Superintendent Hopewell is receiving bids for construction of same.

Xenia, Ohio.—J. S. Jones, president board of trustees Ohio Soldiers and Sailors Orphans' Home, is receiving bids for construction of an electric light plant. Bids will be opened February 23.

Troy, Ohio.—City clerk may be addressed concerning contemplated municipal electric light plant.

Sparta, Tenn.—Mayor may be addressed concerning contemplated electric light plant.

Norfolk, Va.—The Old Dominion Steamship Co. will put in an electric light plant and fire apparatus.

Oxford, N. C.—A. S. Hall is interested in the construction of an electric light plant.

Red Springs, N. C.—A. B. Pearsall may be addressed concerning erection of an electric light plant.

Sparta, Tenn.—A company will probably be organized for the purpose of establishing an electric light plant.

Berkley, Va.—A $15,000 electric light plant will be established.

Lima, Ohio.—Mayor may be addressed concerning proposed construction of an electric light plant.

Memphis, Tenn.—An electric light plant is to be established to light the jail and court house.

Forest City, Pa.—The electric light plant will shortly be completed.

Sherman, N. Y.—The electric light question is being agitated at Sherman.

TELEPHONE NOTES.

Baltimore, Md.—Alexandria will soon be connected by the Home telephone line with Centreville, Manassas and Haymarket. This will be especially convenient to business men in town and country.

Spring Valley, N. Y.—The Westchester Telephone Company will run a direct line to Tuxedo, and will in all probability take in Nanuet, Spring Valley, Monsey, Tallman and Suffern. The company now has lines through Nyack, New City and Haverstraw, and if the above plans are carried out all the most important points in Rockland county will be connected by telephone.

NEW CORPORATIONS.

Corning, N. Y.—The Corning Construction Company has been incorporated by Hosea A. Clark, Thomas C. Frenyear, Marc W. Comstock, Edward J. Slattery, and W. A. S. Chipman; to manufacture electricity for producing light, heat and power. Capital stock, $5,000.

Standish, Mich.—Standish Electric Co. has been incorporated with a capital stock of $20,000.

New York, N. Y.—The United States and Hayti Telegraph and Cable Co., incorporated with a capital stock of $1,800,000, certified that one-half of its capital stock has been paid in.

Big Rapids, Mich.—The Farrman Electric Light and Power Co. has been incorporated with a capital stock of $15.000.

Albany, N. Y.—The Reynolds Turbine Governor Co., of Altamont, has been incorporated with a capital stock of $10,000. Directors, John M. Van Heusen, Garrit Y. Lansing and George D. Atkins of Albany; Willis G. Reynolds of Troy and John C. Pennie of Washington, D. C.; to manufacture patent turbine governors.

N. Y. City.—A charter has been granted to the Pelham Electric Light & Power Co. Directors, Charles W. Smith, John T. Boyd, Thomas F. Conville and Joseph A. Spratt. Capital stock, $100,000.

N. Y. City.—The Midland Electric Lighting Company has been incorporated with a capital stock of $100,000 and the following directors: William B. Rockwell and Merle J. Wightman, of New Brighton, and Ernest G. Wightman, of Stapleton; to operate in the villages and towns of Richmond County.

Pittsburgh, Pa.—The Sewickley Valley electric passenger railroad company, capital $15,000, has been chartered at Harrisburg to build a line about two miles and a half long, beginning at the easterly line of Osborn borough, on the Beaver road; thence extending westwardly through Osborn borough, and through Sewickley. President, James D. Callery, Pittsburgh. Directors, James D. Callery, W. H. Keech, J. C. Reilly, George C. Wilson, Pittsburgh; J. M. Tate, Jr., Sewickley.

Harrisburg, Pa.—A charter has been issued to the Mutual Telephone Co., of Erie. Captal stock, $25,000.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued November 24, 1896.

571,738. Electric Street or Station Indicator. Herman Alwies, St. Louis, Mo. Filed August 10, 1896.

571,739. Electromagnetic Sentinel. Francis B. Badt, Chicago, Ill. Filed February 15, 1896.

571,760. Means for Insulating Electric Conductors. Theodore Guilleaume, Muhlheim-on-the-Rhine, Germany. Filed November 2, 1895. Patented in England May 13, 1895, and in Belgium July 2, 1895.

571,761. Electric Light Cord Adjuster. George L. Gulliford, Bement, Ill. Filed May 9, 1896.

571,769. Electric Igniting Device for Gas Burners.

Gottfried F. Krieger, Kiel, Germany. Filed May 4, 1896.

571,780. Dynamo-electric Machine. William F. Marzahn, Buffalo. N. Y. Filed September 21, 1896.

571,791. Switch for Electric Lamps. Henry R. Quinby, Rochester, N. Y. Filed December 4, 1895.

571,792. Electric Arc Lamp. Henry R. Quinby, Rochester, N. Y. Filed March 12, 1896.

571,802. Globe Attachment for Electric Lamps. Edward Schrantz, St. Louis, Mo. Filed August 15, 1896.

571,825. Electric Motor Railway Truck. John A. Brill and George M. Brill, Philadelphia, Pa. Filed June 25, 1888.

571,832. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa. Filed February 17, 1886.

571,836. System of Alternating Current Regulation and Distribution. Benjamin G. Lamme, Pittsburg, Pa. Filed April 6, 1896.

571,839. Station Potential Indicator. Ralph D. Mershon, Pittsburg, Pa. Filed December 23, 1895.

571,849. System of Electrical Distribution. Oliver B. Shallenberger, Rochester, Pa. Filed November 8, 1896.

571,863. Rotary Transformer Regulation. Ralph D. Mershon, Pittsburg, Pa. Filed April 6, 1896.

571,906. Apparatus for Multiple Switchboards for Telephone Exchanges. Charles E. Scribner, Chicago, Ill. Filed February 7, 1893.

571,907. Telephone. Charles E. Scribner, Chicago, Ill. Filed February 7, 1893.

571,910. Telephone Exchange System. Charles E. Scribner, Chicago, Ill. Filed October 16, 1894.

571,927. Electric Switch. James T. Norton, Boston, Mass. Filed January 28, 1896.

571,946. Electric Arc Lamp. Charles Eschwei, Long Island City, N. Y. Filed September 11, 1896.

571,948. Telegraph. Leo W. Hildburgh, New York, N. Y. Filed March 5, 1896.

571,950. Fire Alarm Signal Box. Geo. F. Milliken, Boston, Mass. Filed December 14, 1891.

571,951. Means for Generating Electricity from Car Wheel Axles. Morris Moskowitz, Newark, N. J. Filed July 19, 1895.

571,952. Electric Switch. Morris Moskowitz, Newark, N. J. Filed June 11, 1896.

571,974. Electric Arc Lamp. George R. Lean, Cleveland, Ohio. Filed May 23, 1896.

571,976. Electric Arc Lamp. George R. Lean, Cleveland, Ohio. Filed July 7, 1896.

571,977. Binding Post for Electric Bells, etc. Frederick W. Manger and Otto H. Huebel, Brooklyn, N. Y. Filed March 24, 1896.

571,994. Trolley Finder. William J. Donahue and Ward B. Hausman, Philadelphia, Pa. Filed October 10, 1895.

572,008. Electric Fan for Ventilating Streets or Alleys. Vespasian V. Hedges, Coffeyville, Kan. Filed Nov. 13, 1895.

572,013. Underground Electric Power System for Railways. William L. King, Winston, N. C. Filed May 21, 1896.

572,036. Wheel with Electric Motor Hub for Vehicles. Charles Théryc, Marseilles, France. Filed July 31, 1896. Patented in France January 30, 1896.

572,057. Annunciator. Franklin A. Jennings, Ithaca, N. Y. Filed May 11, 1895.

572,081. Automatic Temperature Annunciator. John A. Young, Indianapolis, Ind. Filed May 11, 1896.

572,064. Arc Lamp. John Rae, New York, N. Y. Filed November 26, 1895.

E. du Bois-Reymond was born on November 7, 1818, in Berlin. He received there his general education at the College Français, and in 1837 he entered the University of Berlin, where he registered at first in the philosophical faculty, attending various lectures on philosophy, history and even theology. An accidental attendance at one of the lectures of Mitscherlich on experimental chemistry, however, had a deciding influence upon du Bois-Redmond's future. He began to study mathematics and the natural sciences, and went over later to the study of medicine, thus coming in contact with Johannes Müller, who was at that time the professor of physiology and anatomy at the University of Berlin. Du Bois-Reymond became first the "famulus," and later on the "assistant," of Johannes Müller. In 1846 he established himself as "privat-docent" at the University, and in 1855 he was made professor extraordinarius." In 1858, after Müller's death, the chair of physiology was separated from that of anatomy, and du Bois-Reymond was made professor of physiology and director of the physiological laboratory in the University of Berlin, a position which he held to the last day of his life. In 1851, at the proposition of Alexander von Humboldt and Johannes Müller, du Bois-Reymond was elected to the *Berliner Academie der Wissenschaft*, a very high honor for a young man of only 33 years, and since 1867 he was the permanent secretary of the academy. Du Bois-Reymond was an honorary member of numerous scientific societies all over the Old and the New World.

The Electrical Age.

VOL. XIX., No. 8. NEW YORK, FEBRUARY 20, 1897. WHOLE No. 510

View of Trunk Line Subway Consisting of Eight Pipes Built for the New England Telephone and Telegraph Company, Haymarket Square, Boston.

THE LAYING OF CONDUITS FOR ELECTRIC LIGHTING AND POWER.

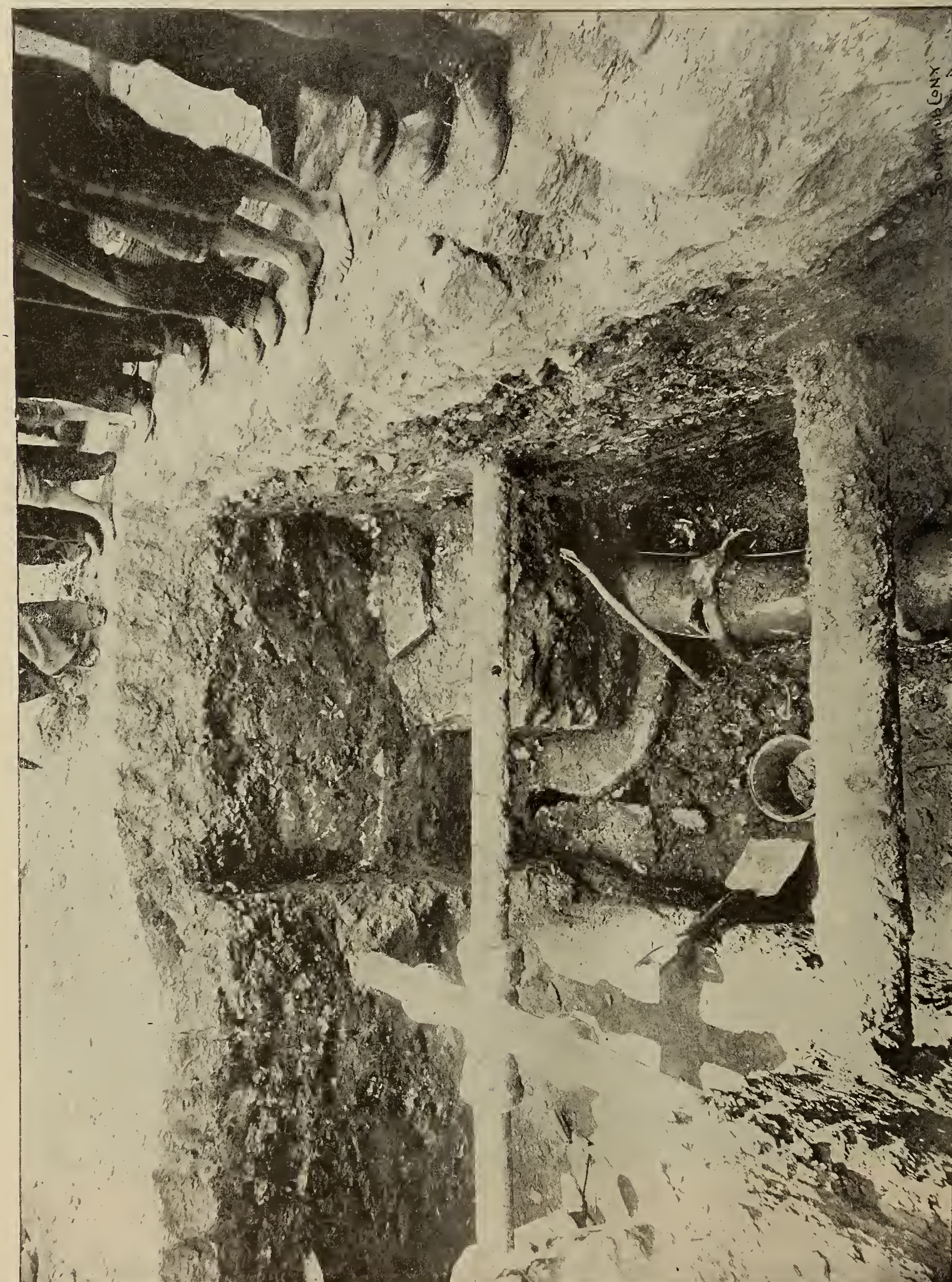
General Introduction.—In the days of Queen Elizabeth a discovery was made which links itself with this present hour, and, in fact, with all the great discoveries of the day. An experimenter of Shakespeare's time named Grey discovered by accident that a wet thread allowed a charge of electricity to pass freely through it. The dry thread and wet thread thus became objects of the closest inspection. We hear of a damp cotton thread many feet in length being suspended by silken loops and used for the transmission of a static charge. In other words, the years may be rolled back four centuries and we meet with an appreciation of the properties of a conducting

and insulating medium, simple and crude in conception, but still bearing so strongly upon the modern work of the day that an admission of the identity of methods used then and now to conduct and insulate is a foregone conclusion.

Use of Copper.—It may seem to be but a step to make a trial of other materials for the purpose of discovering conducting properties, and to pass through the entire list of known metals until the practical conclusion is reached that for commercial purposes copper is the best.

These explorations in the fields of applied science thus enable the men to meet on common ground, those whose lives are spent in the laboratory and those that make use of their discoveries.

The mere passage of a current through a wire and the occasional suspension of it at intervals by insulating supports seems at the first glance a simple enough problem. The long telegraph circuits stretch around the earth like a huge girdle and provide the most familiar example of how electricity may be transmitted from point to point, whether for signals or power it is immaterial. But if the wind and storm of inclement weather be considered and the risks that would attend the flow of a powerful current, from an overthrow of the poles, the breaking of wires or the destruction of insulators, then the use of overhead lines becomes a matter of serious contemplation.



View of Manhole before the Removal of Gas and Water Pipes and Sewer Catch Basin in Atlanta, Ga. This is known as a "Trilby" picture.

Advantages of Conduits—Heavy power or electric light lines, even if well supported overhead, would be a constant menace to the people of large cities. The dangers

of fires and shocks, as recent history indicates, is the inevitable result of this practice. A long-distance overhead power line in Germany is supported on poles decorated with the melancholy insignia of a death's head. There is therefore no lack of appreciation on the part of owners mediums of electrical communication have therefore in common been forced to adopt some method of sending the current in underground conductors whose presence there assures the safety and peace of mind of municipal inhabitants.

View of Trunk Line Subway Built for the New England Telephone and Telegraph Company, Springfield, Mass.

of power and light circuits of the necessary inference to be drawn—of the necessity of putting the wires underground.

A crusade has been successfully carried out against not only electric light, power and railroad companies, but telephone aud telegraph concerns as well, by city and town authorities. The producers of power, light and

The use of many methods for the successful attainment of this object have marked the introduction of the underground conduit.

General principles followed.—As a rule, the copper conductor is surrounded by some insulating material, and that again by a sheath of protecting armor—giving us as the essential parts of a complete conduit,

Conductor,
Insulator and
Protector.

Thus, with these three requirements a great number of conduits and conduit systems appeared of greater or less value. Without criticising those that have passed and gone, or are going, let us pay a moment's attention to the conduits of the National Conduit Manufacturing Company, of the Times Building, New York.

They have drawn, from their fund of experience, certain pregnant conclusions that apply unbiassedly to a successful underground system.

(1) "Properly insulated conductors covered preferably with lead casing to *exclude moisture*, made sufficiently flexible to permit of drawing into the conduits."

(2) Conduits of a smooth interior that are water-tight, gas proof, non-inflammable non-conductors; that are easily and rapidly laid, free from expansion and contraction, made in convenient lengths for handling and laying, possessing greater strength, adapted to all places and conditions, absolutely permanent and cheap.

Manholes or openings into the street giving ready access to the conduits and intermediate boxes for distribution to subscribers,so constructed that easy access can be obtained to the cables without disturbing the surface of the streets.

Many trials and tribulations have been the lot of those trying to lay wires underground. A common conclusion reached points to the use of four materials—lap-welded iron tubes, wood, terra-cotta and wrought iron cement-lined conduits.

The National Conduit Manufacturing Company, desiring to sell a permanent conduit and having in mind the possibility of internal corrosion, selected the wrought iron cement-lined conduit as the superior in durability and strength.

Their tubes are of the toughest wrought iron,lined with pure hydraulic cement, and are laid in the ground in a mass of hydraulic concrete which, solidifying, becomes like solid rock. The cable may thus be slipped in and out with the greatest ease. Illustrations are herewith given showing certain stages of the work and the processes of installation. The National Conduit Manufacturing Co. contract for complete subway systems. Since 1887 they have been laying conduits in this city and have furnished at least eighty-five per cent. of all those laid in America and Canada.

The officers of this company are Edw. S. Perot, president; C. Gallagher, vice-president; James P. McQuaide, secretary and treasurer. The engineering staff is composed of W. H. Lewis, superintendent manufacturing; D. P. Regan, superintendent construction, and H. F. Tate, Western manager. The factory and works are at Hastings-on-Hudson; the Western office, Rookery Building, Chicago.

Electric light by the penny-in-the-slot system is advocated by an English writer. It places the light, he says, within the reach of a much larger number of customers, because it enables them to economize at will in the amount of consumption, and to pay for the commodity by small and immediate installments. When we consider that at the rate of 5d per unit a 3½-watt candle-power lamp will remain alight for over seven hours for one penny, it is more than likely that the consumer will be perfectly satisfied with his bargain. In small towns where the price of gas is not less than three shillings per 1,000 cubic feet, the prepayment system of electricity supply would be a real boon to the working classes, and even where the price of gas is lower the consumer would not notice the small extra cost of electricity when paying for it a penny at a time. The electric light would no doubt receive a great help forward by the adoption of these meters, and it would then become more trnly "the poor man's light," which, in a prophetic spirit, it has already been christened.—Springfield Republican.

EMIL DU BOIS-REYMOND.

(Coutinued from page 101.)

The brilliant scientific career of du Bois-Reymond was again determined by a single accident. In 1841 Johannes Müller handed to his amanuensis Matetucci's paper (Essai sur les phénomènes électriques des Animaux, Paris, 1841) for the verification of the experiments on the so-called frog current of Nobili. It became the task of du Bois-Reymond's life, and he solved it by creating a new science, the science of animal electricity. Already, a year later, appeared his first short paper on this subject (Ueber den sogenannten Froschstrom und die electromotorischen Fische, Poggendorff's Analen der Physik, Vol. 58), and was followed by his thesis (Quæ apud veteres de piscibus electricis extant argumenta, 1843.) Then years of silence followed, years of hard labor, of seclusion in his small private laboratory, where "the frog and the multiplicator were the whole world" to that most energetic of all investigators. The problems, the methods, the instruments, were thoroughly worked out with unparalleled energy, ingenuity, precision and self-criticism, before they were communicated to the world. But then, when his book on animal electricity came out, it was a revelation, it marked an epoch in physiology. In 1848 appeared the first volume of that book, "Untersuchungen ueber thierische Elektricität." In 1849 followed the first part, and in 1860 the second part, of the second volume. It was not simply a communication of new striking facts and new methods; it was an exhaustive statement of the creation and completion of a new science, presented in a brilliant style and in a language unusually clear and full of life and force. His later contributions to the physics of nerve and muscle appeared mostly in the reports of the Berlin Academy of Sciences, or in the Archiv für Physiologie, of which du Bois-Reymond was the editor. Among the fundamental facts which were added by du Bois-Reymond to physiology we have to mention, in first place, the establishment and development of the laws of the muscle current, the discovery of the nerve current, the discovery of the so-called negative variation in muscle and in nerve, the discovery of the electrotonus, etc., etc. Du Bois-Reymond has devised and invented numerous and important scientific apparatus, many of which are to be found in all well-equipped physiological laboratories; for instance, the induction coil, the electric key, the non-polarizable electrodes, etc., etc. Du Bois-Reymond's name will live forever in the science of physiology.

Aside from his special scientific work, we should not omit to mention the public speeches (Reden) delivered by du Bois-Reymond on many special occasions. In those speeches, as a rule, an important subject was treated in a classical style. They were models of clearness and brilliancy, and nearly everyone of his speeches has been an event in its time, and many of them have been translated into all civilized languages. We need only to mention here the following: "Darwin *versus* Galiani," "Die Lebenskraft," "Ueber die Grenzen des Naturerkennens," with his *ignorabimus*, and "Die Sieben Welträthsel." He was as forcible a speaker as a writer. And both his pen and his speech have been employed only for a fearless propagation of high ideals and in defence of the rational principles underlying modern sciences.

His last work was one of love. Shortly before he died he finished reading the proofs of his carefully prepared memorial of his friend Helmholtz.

S. J. MELTZER.—*Science.*

Sturgeon Falls, Ont.—The ratepayers voted on a by-law on the 11th inst. to provide funds for the purchase of an electric light plant.

Shawville, Que.—A local company proposes putting in a plant for electric street lighting.

THE MODERN POWER HOUSE.

BY RICHARD M'CULLOGH.

(Continued from Page 102.)

Notwithstanding the great number of types of boilers on the market, they may be divided into two general classes, fire tube and water tube. In most of the more recent power houses, some form of water tube boiler has been adopted, as this type possesses some marked advantages over the fire tube. They are non-explosive; they may be operated at a higher pressure and, consequently, are more suitable for use with compound engines; they have a large heating surface and are quick to respond to calls for power; they occupy less floor space and are usually more intelligently designed than the other class. On the other hand, their first cost is greater, there is a greater number of joints to be looked after and the cleaning is more difficult, especially in those forms which use a curved tube. It has usually been considered that the efficiency of water tube boilers was much higher than the fire tube, but there is now a form of fire tube boiler being made consisting of a shell of large diameter and extra length, containing a large number of flues, which approaches the water tube boiler very closely in efficiency. The high efficiencies obtained in boiler tests are seldom reached in actual practice, as they usually result not so much from excellence of design in the boiler itself as from careful and intelligent firing during the test.

It is hardly necessary in presenting a paper before this intelligent body to discuss the reasons why water should be fed into the boilers as hot as possible. Besides preventing the straining of the boiler shell from the sudden changes in temperature, there is a large quantity of fuel saved, and the percentage of this saving will be found tabulated in nearly every work on thermo-dynamics. The usual methods employed in heating the feed-water tube are, first by the heat of the exhaust steam, and second by the heat of the escaping flue gases. There are numerous patented devices for utilizing the heat of exhaust steam, either by passing the exhaust through a number of pipes surrounding the feed-water, or by spraying the feed-water across an opening through which the exhaust steam is admitted. Most of these devices are very simple in their construction, and their efficiency depends very largely on the length of time the feed-water and the exhaust steam are in contact, and in case they are in separate chambers upon the conductivity of the separating medium. Care should be taken that the opening for the exhaust steam is never contracted, so that any possible back pressure on the engine is avoided.

The method of heating feed-water by the heat of the escaping flue gases has been applied in apparatus under the general name of economizers. The arrangement usually employed is a coil of pipe containing the feed-water placed in the flue. In order to keep the soot from settling on the pipes, most forms of economizers are supplied with a mechanism for scraping off the pipes whenever necessary. Sometimes the economizer consists of one large bank of pipes placed in the main flue, and sometimes the apparatus is divided into a number of banks each placed in a flue leading to one furnace. The choice of arrangements depends largely upon the size of the plant and the general location of the boilers. By means of a properly designed economizer, feed-water may be heated to a very high temperature, even above the atmospheric boiling point of water. In the use of any device in which feed-water is heated by the flue gases, care should be taken that the escaping gases will still retain sufficient heat for the maintenance of the necessary draft after part of their heat is taken from them by the feed-water. In the case of power houses using natural draft economizers should not be used, where the draft is not already sufficiently strong, or is just barely strong enough for the work to be done. There are in operation, however, many plants using natural draft, discharging flue gases at a very high temperature, much higher than is necessary to maintain the required draft. Economizers used in such cases would result in a marked gain in economy.

Whatever system of heating feed-water is used, the apparatus should be made abundantly large for the work to be done; first, that the water should pass through slowly and receive the full benefit of its contact with the heated gas or steam; second, that a large store of water may be kept on hand which is of great service in case of a sudden demand on the boilers; and third, that the feed-water heating apparatus may act as a water purifier. It has been found that water kept for some time at a high temperature will deposit a great portion of the carbonates and sulphates of lime and magnesia which it has in solution. This is probably due to the expulsion by the heat of the carbonic acid gas contained in the water, thus freeing from solution the lime and magnesia, which it is well known are slightly soluble in water containing carbonic acid gas.

(To be continued.)

COPPER PRODUCTION.

If the production of copper ore should continue throughout the year 1897 on the scale it has thus far shown, states the "Industrial World," and with the same degree of profit to the producers, prospectors will be likely to turn their attention from silver and gold deposits to copper. A special dispatch from Houghton, Mich., thus tells of the profits of Michigan companies:

"The Boston and Montana dividend, declared last Friday, already brings this year's dividends from Michigan copper mines up to $2,000,000, and this company's to $5,375,000 as a total. The Osceola has paid $50,000, and the Quincy, Atlantic and Kearsage are looked on to declare heavy dividends in the coming month. Starting the year with the record-breaking dividend of $1,500,000 from the Calumet and Hecla, local copper mines are figured on to make a better record in 1897 than ever in history. Several of the local companies are said to be able to lay copper down in New York at five cents a pound. Brokers look for a $5 dividend from Calumet and Hecla every two months during the year. But if the foreign demand for copper continues as now a further extra dividend is likely in the year. The control of the Calumet and Hecla is in the Agassiz and Shaw families, which have 63,500 out of its 100,000 shares. Stock in the company is now selling at about $350, its par being $25.

"The Tamarack mine has been sinking No. 5 shaft fifteen months, and it is now 1,000 feet deep: it is to go 3,500 feet more to the vein. It will be six years before it is at this depth, but when it reaches 3,600 feet it will become a possible producer. The single shaft will hoist more copper than many a large mine. The depth of the shafts of copper mines in the Lake Superior district is something that astonishes miners from all over the world, as nowhere else are there such holes and so many of them. At present the deepest is the 5,000-foot shaft of the Calumet and Hecla, but there are some 4,500 feet deep, while one has been started to be sunk to a depth of 10,000 feet. With the completion of the deep shafts in this district at present uuder way, there will be more than $13,000,000 sunk in these holes in the ground and the machinery to equip them."

Speed of Telegraph Signals.—Experiments were recently made at Montreal to discover the length of time required for a telegraph signal to pass from that point to Greenwich by Atlantic cable. Two hundred signals were sent, and it was found that the average time taken by the current to cross the Atlantic and back—a distance in all of 8,000 miles—was exactly 1 1-20 seconds.—Newark Call.

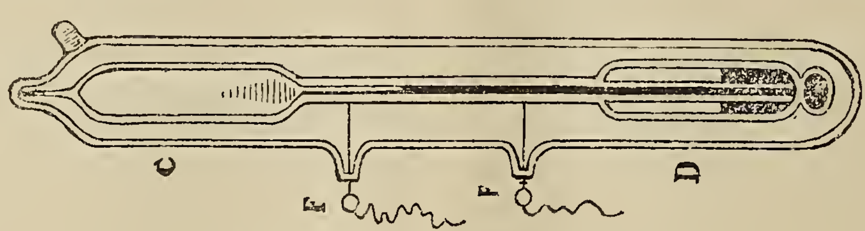
MEASURING SUNSHINE BY ELECTRICITY.

A daily journal makes a most interesting note of the invention of an instrument for measuring sunshine by electricity:

So infinitely delicate is this tiny instrument that not the faintest ray of sunshine that may break through the cloudy arch of a gloomy day is lost, even if it be but of a moment's duration. Not only does it catch these rays of sunlight, but by an extremely clear electrical contrivance it also records the exact amount of sunshine, and the period of the day during which it occurs.

The instruments which record intensity consist generally of two thermometers, the bulb of one of which is coated with lampblack. The records are merely records of temperature—exposed radiation and isolation by black and bright bulb thermometers.

Three forms of recorders of bright sunshine are in use, the Campbell-Stokes burning recorder which consists of a ground and polished crystal sphere, which, acting as a lens or burning glass, scorches a trace, showing the duration of bright sunshine upon a strip of cardboard placed at the proper focal distance from the sphere; the Jordan, or photographic recorder, and finally the electrical, thermometric recorder, spoken of in the introduction of this article. A sectional view of this instrument is shown in the accompanying illustration.



Electrical Sunshine Recorder.

The principle is essentially that of a Leslie differential air thermometer in the form of a straight glass tube, with cylindrical bulbs "C" and "D" at each end; the whole enclosed in a protecting glass sheath, "A." Mercury is used to separate the air in the two bulbs, a small quantity being inserted in the bottom and stem of the lower bulb, "D," which bulb is smoothly coated with lampblack.

The bulbs are filled with pure, dry air and hermetically sealed. The space between the bulbs and the protecting sheath is then perfectly exhausted of air and also sealed.

When the sun shines, its attraction for the blackened bulb drives the mercury up through the stem leading to the clear glass bulb. In its passage it forms a circuit by contact with the two fused-in fine electric wires, at "FF," and the record is carried like a flash to the triple register in the observer's office below. This register is operated by clockwork, and upon its brass cylinder a sheet of paper bearing lines indicating the minutes and hours of the day is traversed by an automatic pen, which, in connection with the electric wires attached to the sunshine on the roof above, keeps an absolutely accurate record of the sunshine duration each day.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—A CONDENSER; ITS CONSTRUCTION.

Albany, Feb. 10, 1897.

Electrical Age Pub. Co.

Dear Sirs:—The majority of spark coils for X ray work have a condenser for the betterment of the coil. What use is it in coil work and how is it made?

Yours truly,
Lyman Cooley.

(A.)—A condenser is used for the purpose of killing the spark at the contact-breaker. Likewise it builds up the pressure of the coil, so that with a condenser of the proper size the coil sparks at its best. The construction is simple; merely layers of well-paraffined paper and tinfoil, the first, third, fifth, etc., of tinfoil connected together and the second, fourth, sixth, etc., likewise.

The two terminals are connected between the vibrator points. By experiment the proper size of condenser is found.

(Q.)—LAMP WIRING.

Toledo, Feb. 4, 1897.

To Editor Electrical Age.

Dear Sir:—I have considerable contracting to do which I sublet to my foreman. I am curious to know how the size of wire is obtained and what means are taken to insure the proper selection? Begging your pardon for what may be a foolish question, I remain,

Yours respectfully,
Myron Deland.

(A.)—The general rules of wiring depend upon the fact that a drop in pressure occurs in a wire carrying a current. The drop is decreased either by decreasing the current or increasing the size of wire.

Two per cent. loss for 110-volt circuits. Lamps × distance × 11 = circular mils.

Two per cent. loss for 50-volt circuits. Lamps × distance × 22 = circular mils.

(Q.)—WEIGHT OF A DYNAMO FROM DRAWING.

New Orleans, Feb. 8, 1897.

Editor Inquiry Column.

Dear Sir:—Having occasion to prepare drawings of a dynamo for college work I thought of asking you to give me an easy way of calculating the weight beforehand. In marine work this is a feature of the utmost importance. Kindly consider this question as soon as possible.

Yours respectfully,
Alfred Deems.

(A.)—The cubic inches of iron can be estimated from the drawings—a cubic inch of wrought iron weighs .28 pounds. The number of pounds of copper on armature and field may be estimated from the number of feet. The weight of shaft bearings, foundation, commutator and pulley can be found.

The coils on field may be considered as so many cubic inches of copper. One cubic inch of copper weighs .3214 pounds.

(Q.)—BEST STORAGE BATTERY CONSTRUCTION.

St. Paul, Feb. 5, 1897.

To Electrical Age.

Dear Sir:—Before buying a storage battery outfit I would like to know how I can judge of the best construction. If you will kindly jot down what you consider the essential requirements of a good cell you will greatly oblige,

Yours respectfully,
John R. Besoin.

(A.)—The first requirement is mechanical stability; next, great capacity per pound weight; also, great discharge rate without injury; no buckling; no sulphating; no disintegration. The buckling is generally due to a heavy discharge; in strong, thick plates it never occurs. Sulphating is caused by acid acting on plate forming a white coating. Occurs if the discharged plates remain in the solution too long.

The Electrical Age.

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CONTENTS.

THE EVOLUTION OF CONDUITS.

There is some pleasure in retrospection, in the sweeping glance that gathers in the alpha and omega of an hour or day, of a year or century. Since the complexities of electrical engineering have unfolded themselves—the mere result has become incidental to the means that caused it—it has become impossible to lay a wire without obeying the rules defined by the municipality unless a flagrant misdemeanor is intended by their defiance. The empirical and too often impractical methods employed in the installation of wires in street or structure have been cried down. Conduits in the thoroughfare and home are now laid according to the best experience, and in durability cannot be excelled. The careless and dangerous methods that entitled those laying wires to sling them in as they saw fit have fortunately been abandoned. The use of wires is no longer an experiment. The subway of an electric light company or the wiring of a building to which it is connected are now departments of engineering that call for skill and experience. They have lost the arbitrariness of construction that surrounded them of old. The use of conduits with their cables within is now thoroughly in line with an adopted system, adherence to which is required by the fire department, and which expunges the great risks previously existing by the introduction of wires poorly insulated and carelessly installed.

The use of conductors of deficient covering became a noticeable feature of electric lighting at an uncertain period in its evolution. The use of so-called underwriter's wire, which invited such risks that it was called "Undertakers' wire," marked an epoch in the use of bad protective insulation for electric power lines. It was deemed necessary to protect as well as insulate conductors. Long before conduits were used in houses conduit subways were being laid in large cities for electric light and power lines.

The dangers arising from the exposure of wires soon aroused public dismay and a war began against all companies whose lines were in open view. This healthful reaction stimulated wire and conduit manufacturers to such an extent that good insulation and protective coverings were soon deemed an essential requirement.

Within buildings the condition of wires received immediate consideration. Safety was only insured by the use of a reliable conduit or a method of insulation that removed all possible doubts. Not so very long ago a building on Fifth avenue wired at a time coincident with this change was examined. The wires lay between the floor and ceiling as though they had been thrown there, merely connecting to the cut-out through a hole in the plaster. The proprietor informed an interested observer that a fire had occurred there, whose cause was probably due to the wires. He was then having his place rewired, but conduits predominated on this occasion.

The introduction of a serviceable conduit for the street and building use has created a wonderful change in the attitude of the public. It has inspired confidence and entirely removed that feeling of unreliability that for so long a period attached itself to electric lighting. Millions of feet of conduit have been laid in the streets of large cities and within the plaster of buildings. Fires due to electric light wires or explosions in manholes are practically impossible. A point has now beenreached in the distribution of electric power, such that the most perfect safety and the greatest durability can be expected from the conduits installed for the protection of those wires its use implies. If evolution calls for the survival of the fittest, then certainly the present conduit is best adapted to the demands of the day, both as regards its fitness and its benefits.

Herbert Spencer believes that there is in certain classes of men a lacking power of description. The novelists supply the glow of color, the greater masses the grey background. We will leave it to the reader's judgment to decide whether the following extract is glowing or colorless, whether its indefinite enthusiasm does or does not merit this quiet notice, and finally whether the famous sea serpent of the Massachusetts coast wonld not feel morally defunct at the news of an engine fifty-seven feet long that possessed, like itself, an "elastic character."

Extract.—The French are now keeping in line with other nations in electric invention. A new electric locomotive of large dimensions, calculated to draw trains of double the weight of those attached to ordinary engines at a rate of sixty-two miles an hour, has been tried with success on the Western Railroad of France line. It is fifty-seven feet. long and of 1350 horse-power. These engines are safer than the others, owing to their elastic character, which enables them to make curves with security at full speed. Great things are, in fact, expected from these contrivances, which, when perfected, will do 100 to 115 miles an hour.

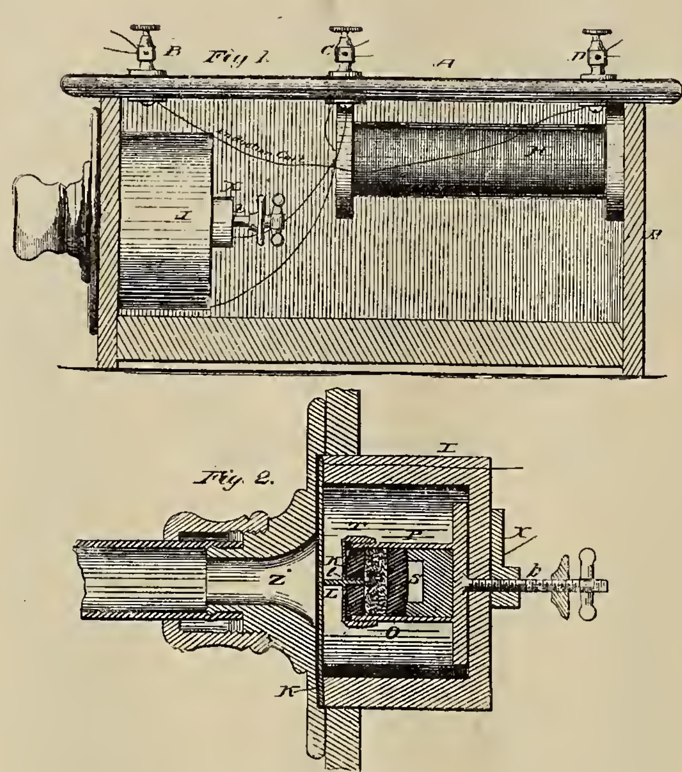
A farmer in Germany does all his work by electric power. A small brook furnishes all of the power needed to run the dynamos, which, in turn, drive all of his farm machinery, pump his water, and light his house and outbuildings. Every operation for which steam or horse-power was formerly used is now performed as well, or better, by this electric plant, which has also the advantage of being always ready for any call upon it. The brook is dammed, and, with a six-foot fall, drives an eighteen horse-power turbine, the prime mover in the circuit of machinery.—Boston Ploughman.

THE TELEPHONE.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

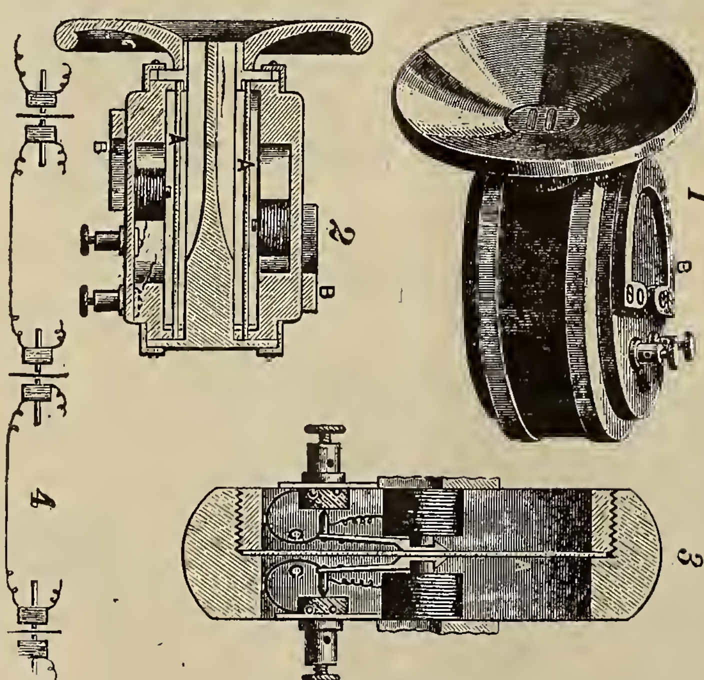
BY NEWTON HARRISON, E. E.

The Receiver.—The invention of the telephone has added greatly to the comforts of civilization by making communication rapid and easy and facilitating business transactions to an extent previously unimaginable.



Gillett's Granulated Carbon Transmitter.

The simple principle of its action has been a source of surprise to the novitiate, and the ingenious methods by which it is possible to throw in and out subscriber after subscriber from a telephone switchboard is truly admirable.



A Double Diaphragm on the Bell Principle.

The most prominent figure in the field of telephony is Graham Bell. After him follow the names of Berliner and Edison, as inventors of valuable additions to the original idea. A vibrating diaphragm is the basis of most acoustic instruments. The purely acoustic telephone consists of a piece of stretched membrane across a hollow drum with a cord or wire connecting both.

The vibrations of the voice striking the diaphragm are transmitted along the wire to the other receiver and there distinguished. The parts constituting a system are, therefore, the

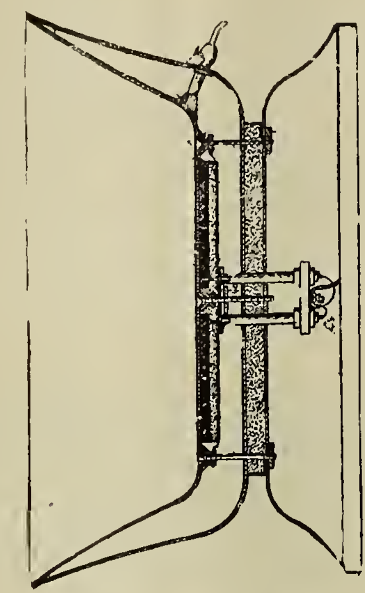
Transmitter,
Receiver,
Line.

In the ordinary form of Bell telephone the parts composing the whole are three, namely:

Permanent magnet,
Coil of wire,
Diaphragm of iron.

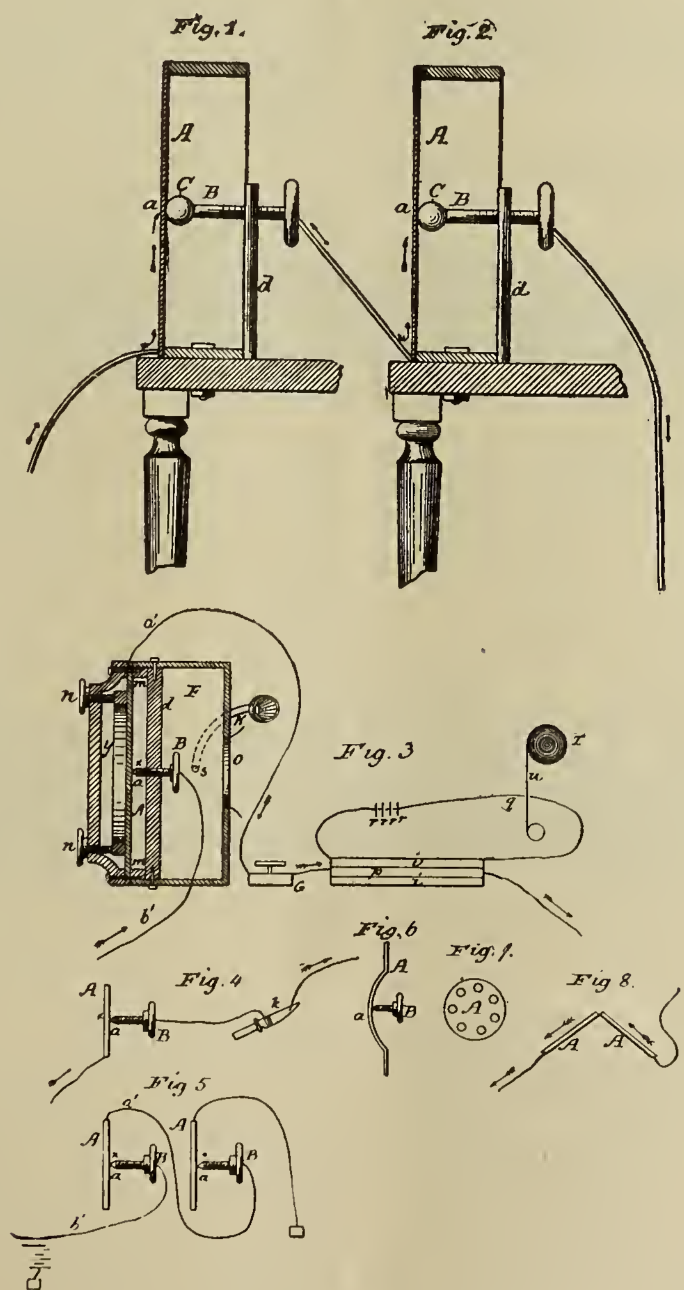
The rod of magnetized steel is placed in a convenient receptacle and a coil of fine wire slipped on one end. The diaphragm is mounted in front in close proximity to the end of the magnet, and a mouth-piece placed so as to focus the sound on it. There is little difficulty in transmitting speech over several miles distance by such a system. In the practice of telephony the Bell telephone is simply used as a receiver for the sound and a somewhat different device used as a transmitter. Reference will be made to this shortly. The receiver, such as it has been described, depends for its action upon a very simple principle. The vibrating diaphragm disturbs the magnetization of the permanent magnet, as follows: When moving nearer to the magnet it increases the permeability of the field and in a corresponding manner decreases it when it moves away. The field is therefore varied in a corresponding manner, and to so definite an extent as to cause these changes to affect the coil surrounding the

magnet. It may be stated at once as a fact in science that the movement of a magnet in the neighborhood of a coil has an immediate effect upon it, developing an E.M.F. in its turns. This physical fact is the basis of the action in a telephone.



A Telephone Transmitter.

The vibrating diaphragm varies the magnetic field of the magnet, the coil placed on its end is at once affected and very small currents are set up in the convolutions.



Original Berliner Transmitter.

The instrument at the other end is perfectly similar in construction and reproduces the vibrations again in its diaphragm, due to the fact that its coil connects with the other coil and all currents set up in the first at once affect the second, attracting and releasing its soft iron in perfect accord with the other.

There is in this simple principle the basis for an investment of twenty-five millions of dollars, which today represents the capital of the Bell Telephone Co. While the delicacy of the Bell receiver cannot be doubted, it is not effective over a long line.

De la Rue estimates the current as not exceeding that which would be produced by one Daniell's cell in a cir-

cuit of copper wire one-sixth of an inch in diameter, of a length sufficient to go 290 times around the earth.

Siemens, a distinguished electrician of Germany, does not think that more than $\frac{1}{10000}$ of the entire sound the transmitter receives is reproduced by the receiving instrument, and Roentgen concludes that no less than 24,000 currents are transmitted in one second by the instrument.

The extreme delicacy of the device employed needs no further discussion here, yet it is at times surpassed in this respect by the unequalled sensitiveness of the line itself to external influences of an electrical nature. The diaphragm can be dispensed with and a clear sound heard through the remaining parts.

This is simply cited as an experiment, not as the usual practice.

A rod of soft iron can be used instead of steel for the core of the coil. This necessitates the use of a battery in circuit, which would otherwise be dispensed with.

There is no doubt that the telephone is extraordinarily sensitive, and may be used for the detection of currents which would otherwise escape notice.

Contrary to the expectation of practical men the telephone works best with a diaphragm of ferrotype iron instead of very thin iron. The extreme susceptibility of the receiver places it in excellence far beyond any of the acoustic inventions of the age.

The microphone.—Before explaining the details of construction of the modern transmitter it is necessary to understand the principle of the microphone, of which the transmitter is simply a development.

This peculiar piece of apparatus was invented by Prof. Hughes, and depends for its action upon the change of resistance in two pieces of carbon placed loosely in contact, and forming part of an electric circuit in which is included a Bell telephone receiver.

Two blocks of carbon are slightly hollowed out to receive between them an upright piece of carbon pointed at each end.

THE TELEPHONE AND LINE.

This is in circuit with a receiver and a battery. If the carbon attachment be mounted on a well-built sounding board, the least vibration affects it at once and causes the carbon pieces to jar together, causing a harsh, crushing sound to be heard in the telephone, greatly magnified, and giving the impression of a large body dragged over rough gravel. The ticking of a watch sounds like the heavy blows of a sledge-hammer, and the walking of a fly approaches in loudness the stamp of a horse.

The tap of a finger on the board, scratching of the nail or beating of the pulse, has been heard by means of this contrivance miles away. It is on this principle the transmitter of a telephone has been constructed, and its application is due to the combined efforts of Emile Berliner and Thomas A. Edison.

The compression of the carbon by these slight vibrations allows the current to increase or decrease an imperceptible amount. To the telephone, however, this minute change in resistance means a variation in current that at once produces the extraordinary effects above described.

Transmitter.—The wonderful delicacy of the microphone has therefore been the basis for the construction of a most easily affected piece of apparatus susceptible to sounds otherwise lost. It is, perhaps, the only apparatus by which the voice could be heard over a long distance; and its ready application to telephone practice has been the means of saving the system from other than local use, allowing its extension over hundreds of miles—with the possibility in the future of its further use for transatlantic communications.

The outgrowth of the transmitter from the microphone has been most effective in developing telephony to an extent otherwise inconceivable.

The transmitter, which renders speech clearer than any other piece of mechanism at the other end, is a direct duplication of the microphone. The sounding-board is not necessary, because the minute changes of current experienced by the transmitter at once affect the receiver and cause it to repeat acoustically and instantaneously the uttered sounds.

Principle of Transmitters.—The grating of the carbon pieces upon each other varies the resistance of the contact. A *decrease* in resistance occurs when the carbons are compressed and an *increase* to the normal status when the pressure is relaxed.

Many forms of telephone transmitters may be built on this basis. A contact which varies with the vibrations of the voice is the means by which a telephonic system may be constructed. The pieces whose resistance is supposed to vary and thus change the current need not necessarily be made of carbon. Many compounds have been used for this purpose of a metallic nature. The changes which occur and shake the enclosed particles are sufficient at times to *pack or compress* them to so great extent as to render the transmitter insensitive to delicate vibrations and consequently useless for long distances. The *varying contact* and *diaphragm* are the subject of much thought by inventive minds.

The diaphragm sounds which fall ineffectively against the diaphragm are lost, and the timbre of the voice with them, for they constitute the distinguished feature between voice and voice and the most characteristic tones of the ordinary speech.

The carbon contact may be in the form of a tube with a carbon block at each end. The tube is filled with granulated carbon and varies in resistance as the blocks at each end compress the particles within. As remarked before, the degeneration of the transmitter is heralded from the time the carbon begins to pack. Alloys of high resistance metals have been used ground into powder with no success.

Diaphragms made up of laminæ have appeared on the market, but the delicacy of the instrument has not appreciably increased by their use over a long line, and the overtones do not leave their impression on the receiver. A large transmitter is equally ineffective and impracticable, by conveying the sound in greater volume but with corresponding deficiencies in tone and evenness.

Carbon Button.—The carbon button upon which Edison's invention rests is attached to a strip of metal, and the vibrations of the diaphragm reach it through the medium of a double-pointed attachment touching the diaphragm and the button. In circuit with the transmitter is a battery and coil of wire. When the transmitter is used, the changes of current vary the magnetism of the coil by increasing and decreasing it. A coil of fine wire wound around the first responds to these changes and sends the minute pulsations over the line to which it is connected.

Lines.—Lines are made either of copper or iron. The usefulness of a line as an efficient means of communication between two distant points depends upon its conductivity and insulation; with good insulation and bad conductivity, or poor insulation and excellent conductivity the fault is equally reprehensible.

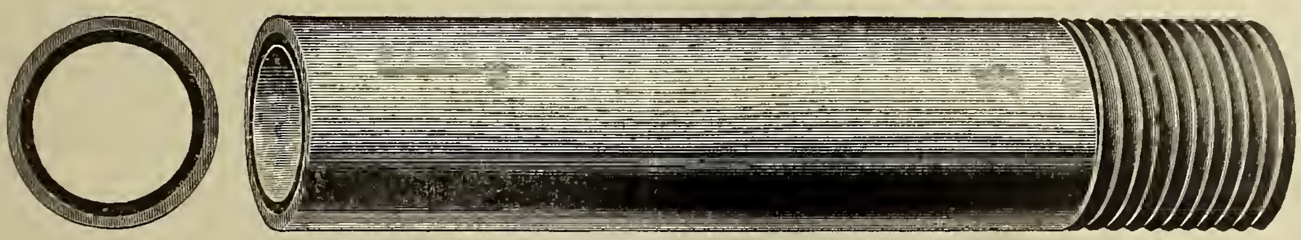
A relation between the conductivity of the line and its insulation resistance should exist and if possible be preserved in practice.

Long lines for either telegraphic or telephonic purposes are necessarily subjected to more leakage, because of the increased number of poles, than short lines. Yet short lines may be very defective, having high resistance in themselves and a character of insulation which compels criticism Long lines have their insulation pulled down because the many glass insulators to which they are attached each allow a slight leakage to occur and thus in total create quite a flow of electricity to the earth. A relay at the end of a telegraphic line in such a case may be affected or lose its sensitiveness, and a telephone system fail in many respects, by leaving itself open to accident from other power-bearing lines in the vicinity.

CONDUITS FOR BUILDINGS.

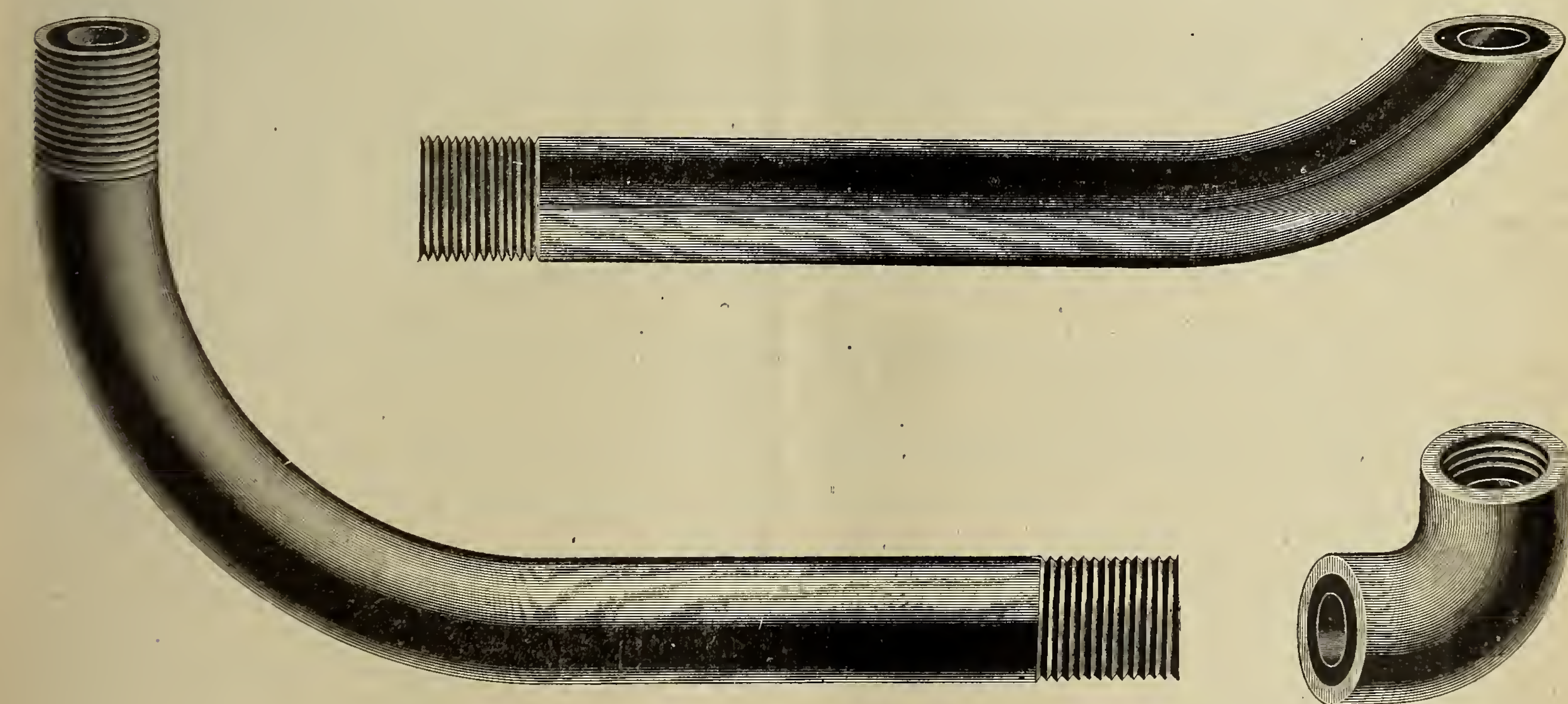
The universal acceptance of the fact that in the course of time, not very far distant, electric wiring will be commoner than gas-fitting, gives a commereial importance to electric light work, its machinery and accessories that can hardly be too well appreciated.

The experimental stage of electric lighting has passed. It is now a matter of as much security to install a lighting generator as a heavy Corliss engine. The science of electrical engineering in its practical branches has become positive and unimpirical. And the use of electricity for light, heat and power is no longer a matter of doubt but of distinct assurance. When the pages of the



New Iron Armored Insulating Conduit.

past are turned back there is a noticeable drift perceivable in the methods of electric lighting that stands prominently forth from amidst the mass of data and experiments. It would seem that electric lighting could only succeed when the dynamo was perfected; this is a fallacy as great as that which would be accepted were we to believe that reservoirs of water outside a city solved the problem of its supply. The great and important point therefore lies in a proper understanding of the best



Showing Styles of Elbows of New Iron Armored Insulating Conduit.

method of distributing the water; the use of pipes that will not corrode and which will stand the strain of passing drays. In a similar manner, though within a building and seemingly exempt from such difficulties, we have before us the problem of supplying current to its different sections without the risks of fire or the losses of leakage. In order that a wiring system may endure it must be protected from injury and thoroughly insulated from contact with external objects. Both strength and insulation are prime requisites in the successful installation of electric light wires.

The Interior Conduit and Insulation Co., with offices and works at No. 527 West Thirty-fourth street, New York, have made a careful study of the best method of installing wires, and their experience has enabled them to produce the new iron-armored insulating conduit for that purpose. This conduit, which is the safest encasement a live wire can have, consists of a wrought iron pipe of about one-sixteenth of an inch thickness lined inside with a durable and highly insulating material. While building construction is going on, the conduit may be installed with perfect immunity from danger. Neither mason, mechanic nor any other workman can injure this highly protective covering. The conduit system becomes convenient and flexible by the use of junction boxes, fittings, etc., similar to those employed with the standard iron-armored and brass-armored conduit systems mentioned in this company's catalogues.

There is an element of surety about the new iron-armored insulating conduit which gives it all the qualities of gas or water pipe; the same tools being used in either case for its handling. Under concrete or tiled floors its superiority is at once manifest and its durability unquestionable.

Some samples are illustrated showing the flexibility of the system, how any twist or turn can be made by the use of elbows of all curvatures.

The great superiority of this conduit to all previously used for interior work removes any discussion as to the best choice. Fires are impossible with wires thus enclosed, and no better proof can be adduced to strengthen this opinion than that of the underwriters' in allowing the insertion of a *twin conductor* in a *single tube* of this new iron-armored conduit.

(Extract from Underwriters' International Electric Association).

"Note.—The use of two standard wires (see page 34), either separate or twin conductor, in a straight conduit installation is approved in the iron armored conduit of the Interior Conduit and Insulation Company, but not in any of the other approved conduits. (See page 15, Rule 22, e)."

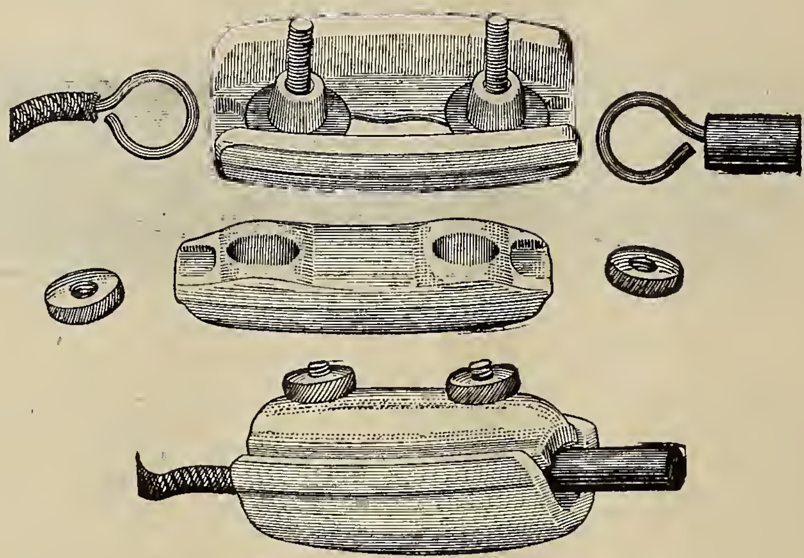
REYNOLDS' SELF-INSULATING CUT-OUT.

An invention that possesses some new and valuable features has been placed upon the market in the form of a "bug."

It requires no cover; the porcelain cap and the base practically compose the entire apparatus. Pressure of the upper cap, secured by the use of two knurled nuts, forces the wire extremities in place. The fuse wire lies between the two. A pair of metal posts keeps the cap in position. The illustration gives the actual size of bug and indicates the method of adjustment deseribed. S. K. Reynolds, agent, 136 Liberty street (Limited), N. Y.

A NATIONAL UNIVERSITY.

The reconstruction of the University of Paris, the efforts in and out of the British Parliament to make a University of London, the great success of the University of Berlin, and the renewed advocacy of a National University at Washington, indicate a movement which, we believe, makes for the progress of education and science. There are dangers in centralization, but these are small in comparison with the promise of great centres, where specialization and co-operation can be carried forward to the degree demanded by the present state of learning and science.



Reynolds Self-Insulating Cut-Out.

It is suggested that the windsails on board steamers might be replaced with advantage by electric fans. In war ships the fan ought to be placed where room can be found for it low down in the ship, far below the water line. An electrically driven horizontal fan, with its motor, can be got into the thickness of a deck with its beams, if need be. This would clearly be better than depending on a flimsy construction, which would certainly be greatly damaged, if not entirely shot away, in action. If clear decks are wanted, the windsail is as inconvenient as it is ugly, and that is saying a great deal.—N. Y. Commercial Advertiser.

The Edison Company Meeting.— The annual meeting of the Edison Electric Light Company, of Philadelphia, was held yesterday at the principal office of the company, northeast corner of Tenth and Sansom streets. As the capital stock is now owned principally by the Heat, Light and Power Company, there was no general interest and but few were present.

The annual report showed an increase in business, represented, partially, by an increase of 18,575 lamps in use. There were increased net earnings of $35,000, and an increase of 16,471 feet in the length of underground conduits. All the conductors of the Edison Company are placed underground.

The annual election for directors resulted in the choice of Martin Maloney, William L. Elkins, Charles M. Swain, Samuel B. Huey, George S. Graham, Sidney F. Tyler and W. W. Gibbs. The number of directors has been reduced to six, instead of eleven, as the board was formerly constituted.—Philadelphia Ledger.

Instruments have been placed in position at the Utica electric light works whereby city officials can ascertain the amount of light being furnished, and if it is not up to contract specifications deductions can be made. The instruments were prepared by the Bristol Manufacturing Company of Waterbury, Conn., and Utica is said to be the first city to put them into use. The city's contract with the electric light company provides for a reduction in the bill for any light reported out for over thirty minutes, one for measuring the amperes and the other for taking the voltage.—Binghamton Republican.

It is not necessary to take up space in this journal to set forth in detail facts on which we are all agreed—that universities are necessary for the progress and even the preservation of our present civilization; that America should have universities equal to those of any other country; that the founding of new universities, such as Johns Hopkins, Chicago and Stanford has been productive of good; that the establishment by gifts or bequests of a university at Washington greater than any other would be received with universal satisfaction. It is, however, desirable to consider the objections that have been urged against the establishment, by the government, of a national university at Washington. These may be reduced to three; the cost of maintenance, the risk of political intermeddling and the alleged interference with existing institutions.

A national university should be supported by liberal appropriations, but the cost is not as great as is sometimes supposed. The annual salaries paid at Berlin amount to less than $200,000. The United States spends about $175,000,000 annually on its common schools. No one grudges this large sum, and yet it is spent chiefly for the benefit of the individual, whereas the higher education is chiefly for the benefit of the state. All the money spent on universities since the first beginnings at Paris and Salerno has been paid back by the results of the education of one man such as Faraday or Pasteur. Higher education in America has been liberally endowed by rich men, but if it is desirable to have these endowments it seems needless to be dependent on individual initiative. Whether the money come from endowments or from taxation it must be taken from the wealth of the country. It may represent a part of the extra price paid for each gallon of kerosene oil, or it might result from a tax paid on the $10,000,000 worth of precious stones annually imported and used chiefly for purposes of ostentation. We might as well wait for rich men to give our government ships of war as to be dependent on them for our educational institutions. A university supported directly by the people would have peculiar influence and special dignity.

(To be Continued.)

WE have a number of sets, three volumes each, of Thompson's Dynamo Electric Machinery, up-to-date. Call and see them. We will make advantageous terms so that you can have these valuable works. The Electrical Age Publishing Company, World Building, New York.

POSSIBLE CONTRACTS.

Grenada, Mass.—The mayor may be addressed for information concerning construction of electric light plant.

Malden, Mo.—G. W. Peck, mayor, may be addressed concerning erection of electric light plant.

Clarksville, Tenn.—The mayor may be addressed for information coneerning the establishment of an electric light plant.

Van Buren, Ark.—The mayor may be addressed concerning erection of an electric light plant.

Jacksonville, Fla.—Superintendent Patterson will recommend the expenditure of $20,000 for increasing the capacity of the electric light plant one-third.

Penacook, N. H.—An electric lighting plant will probably be established at the Valley of Industry, Boscawen Plain.

Pittsburgh, Pa.—U. J. L. Peoples may be addressed concerning erection and completion of electric light plant.

Salem, Mass.—City Clerk may give information concerning establishment of electric lighting plant.

East Hardwick, Vt.—A movement has been begun to establish an electric light plant.

Vassar, Mich.—City Clerk may be addressed concerning establishment of electric lighting plant.

Deer Creek, Ill.—Town Clerk may be addressed concerning proposed erection of electric light plant.

Redwood Falls, Minn.—A. C. Bunheister has been granted franchise to construct and operate an electric light plant in this city.

Salisbury, Md.—Philadelphia capitalists will erect an electric light plant.

Takoma Park, D. C.—Town Clerk may be addressed concerning proposed erection of electric light plant.

NEW CORPORATIONS.

Chicago, Ill.—The Evans Electric Company has been incorporated by Andrew J. Evans, Walter Simpson and Theresa Durham. Capital stock, $2,500.

Jacksonville, Fla.—L. R. Benjamin, Luther M. Clements and William H. Harwick have incorporated the Benjamin Park Railway Company, with a capital stock of $5,000.

Harrisburg, Pa.—A charter has been issued to the McIntosh Electrical Company, of Beaver. Capital stock, $20,000.

St. George, S. I.—The certificate of incorporation of the Midland Electric Light Company has been filed in the Richmond county clerk's office. The capital is $100,000.

Baltimore, Md.—The Catonsville Ice, Light and Power Co. has been incorporated by Bernard N. Baker, Victor G. Bloede, Wm. H. Gorman, Chas. C. Macgill, Wesley M. Oler, Hanson Robinson and Conway Robinson. The company will erect a plant for supplying electricity for light and for manufacturing ice, etc. Capital stock, $100,000.

Downieville, Cal.—The Downieville Electric Co. has been incorporated by William V. Lockwood, R. B. Elder, Robert Forbes, Earl McDonald and Adam Denmire. Capital stock, $20,000.

Barnesville, Minn.—A stock company will be organized for the purpose of putting in an electric light plant.

Rome, Ga.—The Rome Lighting Co. has been incorporated by J. L. Bass, R. J. Ragan, S. S. King and others; for the purpose of erecting electric light plants, etc. Capital stock will be not less than $20,000 nor more than $100,000.

Ann Arbor, Mich.—Ann Arbor Electric Co. has been incorporated with a capital stock of $60,000.

Arkadelphia, Ark.—The Arkadelphia Water and Electric Co. has been incorporated, with C. V. Murray, president; E. W. McCorkle, secretary, and W. E. Barkman, treasurer. Capital stock, $50,000.

Bellbuckle, Tenn.—The Bellbuckle Telephone and Electric Light Co. will be organized to erect electric light plant and establish telephone system.

Excelsior Springs, Mo.—The Excelsior Springs Gas and Light Co. has been incorporated by R. L. Yeager, A. R. Strother and J. B. Forbis, Jr., with a capital stock of $2,000.

NEW TELEPHONE COMPANIES.

Hazelton, Pa.—A new telephone company has been organized in this city, and application for a charter, with right of way privileges extending over Luzerne, Lackawanna, Lehigh, Carbon, Columbia and Schuylkill Counties, has been filed. The incorporators are Hon. C. W. Kline, John G. Seager, Frank McHugh, Charles Mans and John W. Crellin. This company is organized under the name of the Anthracite Telephone Company.

Los Angeles, Cal.—Home Telephone Co. has been incorporated by Louis F. Vetter, Alonzo B. Case, F. W. Braun and John D. Works. Capital stock, $500,000.

TELEPHONE PATENTS.

572,108. Ear-Piece for Telephone Receivers. De Witt C. Farrington, Washington, D. C. Filed April 3, 1896.

572,182. Telephone Transmitter. Forest A. Ray, Boston, Mass. Filed October 23, 1895.

572,188. Telephone Transmitter. Louis D. Appleman, Waynesborough, Va. Filed March 19, 1896.

572,218. Needle Plug Test System for Multiple Switchboards. Charles E. Scribner, Chicago, Ill. Filed June 1, 1888.

572,219. Cord Switch for Telephone Switchboards. Charles E. Scribner, Chicago, Ill. Filed May 14, 1894.

572,220. Electric Signal Bell. Charles E. Scribner, Chicago, Ill. Filed May 31, 1894.

572,221. Telephone Exchange System. Charles E. Scribner, Chicago, Ill. Filed October 10, 1894.

572,222. Telephone Circuit. Charles E. Scribner, Chicago, Ill. Filed August 1, 1895.

572,223. Apparatus for Telephone Switchboards. Charles E. Scribner, Chicago, and Frank R. McBerty, Downer's Grove, Ill. Filed June 6, 1894.

572,111. Combined Electric and Gravity Pleasure Railway. James A. Griffiths, Philadelphia, Pa. Filed April 7, 1896.

572,124. Insulated Joint for Light Fixtures. William McElroy, Brooklyn, N. Y. Filed July 26, 1892.

572,131. Electric Clock. Joseph A Schulte, Arcadia, Iowa. Filed August 12, 1895.

572,158. Electric Sign. William Connell, Pittsburgh, Pa. Filed March 10, 1896.

572,162. Magnetic Separator. Joseph B. Hamilton, Springfield, Mass. Filed December 5, 1893.

572,169. Electrically Actuated Railway Switch. Rudolph M. Hunter, Philadelphia, Pa. Filed July 25, 1894.

572,198. Accumulator or Secondary Battery. Friedrich W. Ellermann, Vienna, Austria-Hungary. Filed December 16, 1895. Patented in France August 24, 1894; in Belgium August 24, 1894; in England August 24, 1894; in Hungary May 30, 1895; in Austria July 23, 1895, and Germany August 24, 1895.

572,215. Insulated Electric Conductor. William R. Patterson, Chicago, Ill. Filed December 10, 1894.

572,285. Battery Cell. Charles Willms, Baltimore, Md. Filed August 15, 1896.

572,301. Electric Door Operating Apparatus. Oliver H. Hicks and Robertus F. Troy, Chicago, Ill. Filed January 28, 1896.

572,319. Electric Switch. Charles B. Sterling, New York, N. Y. Filed June 13, 1895.

572,354. Electric Lamp Post. James Buckner, Boston, Mass. Filed December 26, 1895.

572,369. Magnetic Ore Separator. Charles J. Reed, Orange, N. J. Filed September 3, 1891.

572,370. Mechanism for Separating Magnetic from Non-Magnetic Substances. Charles J. Reed, Orange, N. J. Filed December 30, 1891.

572,377. Electric Towing Apparatus. Adam E. Schatz, New York, N. Y. Filed January 19, 1893.

572,378. Annunciator Drop. William Schwagerman, Yonkers, N. Y. Filed February 24, 1896.

572,380. Voltmeter. Alvan A. Simonds, Dayton, Ohio. Filed March 20, 1896.

572,421. Regulator for Incandescent Electric Lamps. William Hawker, Montreal, Canada. Filed May 29, 1896.

572,430. Electric Lighting Mechanism for Bicycles. Francis E. Magee, Brooklyn, N. Y. Filed March 25, 1896.

572,431. Electric Lamp. Francis E. Magee, Brooklyn, N. Y. Filed March 25, 1896.

572,438. Cell or Box for Electric Batteries. John M. Moffat, London, England. Filed May 23, 1896. Patented in England May 30, 1894, and in Germany March 26, 1895.

572,449. Electric Steam and Gas Engine. Francis A. Rich, Telluride, Colo. Filed May 9, 1896.

572,467. Electric Heater. Burton E. Baker, New Britain, Conn. Filed June 4, 1894.

572,472. Anode for Electrolytic Processes. Hamilton Y. Castner, London, England. Filed July 26, 1895. Patented in England October 20, 1893, and in France August 11, 1894.

572,510. Method of and Apparatus for Transforming Alternating Electric Currents. Maurice Hutin and Maurice Leblanc, Paris, France. Filed November 4, 1892. Patented in France September 3, 1892, and in England October 6, 1892.

ELECTRIC STOCK QUOTATIONS.

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	35	38
Eddy Electric Mfg. Company,	—	19
Edison Illg. Co (St. Louis),	1	2
*Edison Elec. Illg. Co., New York,	104½	105½
Edison Elec. Illg. Co., Brooklyn,	96½	97½
Edison Ore Milling Co.,	7	10
Edison Elec. Storage Company,	28	29
East End Electric Light	—	10
Fort Wayne Electric Company,	½	1
Ft. Wayne Elec. Co. T. Sec. Series A,	3	3½
General Electric Company,	34½	34⅞
General Electric Company pf.,	74	76
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	81½	82
Rhode Island Elec. Protec. Co.,	110	122
Toronto (Canada) Elec. Light Co.,	125	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4
Thomson-Houston Welding Co.,	5	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse El. & Mfg. Co., pf.,	50½	50¾
Westinghouse El. & Mfg. Co., assd.,	24¼	25½

*Ex dividend.

The Electrical Age.

VOL. XIX., No. 9. NEW YORK, FEBRUARY 27, 1897. WHOLE No. 511

The Laying of National Underground Conduit for the Installation at the Capitol—Contractor J. P. Hall.

ELECTRICITY AT THE CAPITOL.

An able and highly commendable piece of engineering has been completed at the United States Capitol, Washington, D. C.

Mr. J. P. Hall, electrical engineer and contractor, of 143 Liberty street, New York, installed the plant to which reference is made.

Many additions and changes have been proposed in the lighting of the legislative buildings in Washington. The work recently performed by Mr. Hall represents, in many respects, the crystallization of these ideas and will, we think remain an unchanged and permanent feature of the capitol's equipment.

The plant consists of a Kodak type of direct-connected Westinghouse generator and engine.

The generator is of 187-kilowatts capacity, and furnishes current for one-hundred enclosed globe arc lamps of the Manhattan construction. These lamps are placed on old-fashioned gas lamp posts of ornamental design.

Likewise installed within the capitol grounds are plain gas posts similarly equipped.

In the illustration the foreground shows one of the ornamental posts.

Mr. Hall used the National underground conduit, cement lined to the extent of 16,000 feet.

A section of the same is shown in the illustration. Mr. Hall wired the ceiling of the House of Representatives for 1,200 thirty-two-candle-power lamps, and the Senate for 1,100 thirty-two-candle-power lamps. Moulding was used throughout the work, and the wire manufactured by the New York Insulated Wire Co. The contract was carried to a successful issue, meeting the expectations of all parties concerned.

SOME FACTS RELATING TO GAS AND ELECTRICITY.*

BY J. F. SEAMON.

With these preliminary remarks, I desire to call your attention to the central station as compared to the gas plant. We must recognize the efficient means which are applied to the different stages of gas manufacture, and while a gas plant's success to a great extent depends upon a correct registration of the product manufactured and sold, and the ample storage of the same, the same principles are applicable to a central station and the distribution of their product, which principles are now being adopted by electrical engineers in the designing of them. It is necessary for the sale of any product to require some suitable means of measurement. As electric power is undoubtedly a product requiring the erection of a costly plant for its production, a unit of measurement is necessary, as well as an apparatus to record the units delivered to the consumer by the producer, and as appliances for recording electric energy, which register in ampere hours (the unit of quantity) and watt hours (the unit of work), are now being generally adopted, it thus makes electricity an equal competitor with gas when such devices are used for the measurement of their product. The writer's experience with the plant in his charge, when electric meters were applied to the consumer, found a reduction in the daylight load of 60 per cent., and the night load of 25 per cent., against that of the contract system. As electric stations receive the benefit of this reduction, and where the revenue by the adoption of meters is not decreased, a majority of electric stations have been unable to lessen the cost of their product to the consumer on account of the variable load they are subject to, making it a necessity to have the machinery and dynamo capacity of sufficient size to carry them through the maximum hours of lighting, which covers an average of three hours in twenty-four. As this machinery represents an investment of capital, and, considering the interest, depreciation, insurance and repairs, with no reduction in the cost of attendance, we readily see that in a majority of cases the cost of electricity to consumer is not lessened. The only material reduction would be that of the fuel and water account, which, under the peculiar conditions stated above, amounted to a saving of 20 per cent. In view of the facts stated, gas companies have been able to hold their share of the lighting business, and in many cities they have increased their output by the aid of efficient methods of applying their product as a source of illumination.

Comparing the storage battery with that of a gas holder the electrical engineer, in order to store his energy, must incur a loss of not less than 20 per cent. of the energy stored, and must pay for his storage battery at the rate of $30 per horse-power hour, whether tee capacity be large or small, but, on the other hand, the method of storing gas involves no appreciable loss of energy. A 50,000 cubic foot holder, at a cost of $7,000, would be 14 cents per cubic foot capacity, and $3.50 per horse-power hour capacity. Assuming that the consumption of gas is 25 cubic feet per horse-power hour, making a difference of 88 per cent. in the cost of storing an equal amount of energy by the means of a storage battery compared to that of the gas holder. And again, if we desire to compare the cost of installing a storage battery to that of a gas holder of equal capacity, we find that, allowing for leaks and condensation, and using the factor of 10 cubic feet per burner per hour, a holder of the size mentioned will furnish gas for one hour to 5,000 burners, at a cost per burner capacity of $1.40. To ascertain the cost of a storage battery of sufficient size to furnish energy to 5,000 16-candle-power lamps at 50 volts, it is necessary to reduce to watt hours, adding 20 per cent. for loss of energy, which equals 300 kilowatts, which reduced to horse-power hours we get a product of 402 horse-power hours; multiplying this by $30, the cost of a storage battery per horse-power hour, we have a total of $12,000 for the cost of the installation of the same of equal capacity to that of a gas holder. It may be stated that storage batteries are confined to the direct current system of electric distribution, and that system is now being superseded by the adoption of the alternating current system in central stations, as the latter, on account of its high potential, covers a greater area in long distance transmission. With the comparisons just stated above, we find this important question of the storage of electric energy a costly one to install, not mentioning the fact of its cost of maintenance, and as the question of capital invested carries with it to a great extent the selling price of any commodity, we can see in this instance its direct application to electric stations, for it necessitates either a means of storage or a sufficient dynamo capacity to carry them through the maximum load.

The gas engine is now being recognized as an important factor for the generation of energy in electric lighting stations, and also in isolated plants, and as it is conceded that it is cheaper to distribute an equal amount of energy by the aid of gas mains than by the method of electrical distribution, and, admitting this to be a fact, it remains for the gas engineer to set forth the practical economy which can be obtained through the agency of the gas engine. The writer calls your attention to one plant in particular at Belfast, Ireland, where gas engines have been installed for the generation of electricity. The gas used was somewhat less than 24 cubic feet per electrical horse-power, the test extending over a duration of six hours at full load. The electrical equipment in this instance consisted of four bipolar dynamos, of 57½ kilowatts capacity each, and two similar dynamos of 26½ kilowatts capacity each, making a total of 380 electrical horse-power.

In the large cities we find a number of isolated electric plants, and as it is necessary for the electrical engineer in the design of these installations to use a means of producing his energy at a minimum cost, it would suggest that a little enterprise on the part of the gas manager, and with the co-operation of the electrical engineer and the gas engine manufacturer, the means can be employed to extend the further use of gas as a productive power, thus closely identifying these branches of business, making them dependent to a certain extent upon the other.

In regard to gas as an illuminant as compared to that of electricity, the writer's experience has been, where gas dispelled that of electric light of equal luminosity, a saving of 71½ per cent. was gained in favor of gas, thereby benefiting the consumer. The Welsbach burner was used in this comparison, and the cost of renewing mantles in obtaining the above result is included. With the adoption of the Welsbach burner for gas illumination it certainly was and now is a serious obstacle in the general advancement of electricity for illumination where there is competition. And as the success of the prepayment meter plant is established, a combination of both burner and meter used would enable gas companies to obtain a

* From a paper read before the thirteenth annual meeting of the Ohio Gas Light Association.

trade that hitherto was an unknown factor to them. As a manager of a combined gas and electric plant, the writer recognizes whatever is to the consumer's interest, in the method of lighting, is to his interest also, and it only remains for him to give an uninterrupted service and a good quality of light at a minimum cost, using his best judgment in the economical running of his plant, and what additions of extension will be the most profitable to the interests he represents.

BICYCLE FACTORY OPERATED BY ELECTRICITY.

An installation interesting to bicycle manufacturers in particular and to all other manufacturers in general, is now underway at Middletown, Conn., where the Keating Wheel Co. have just completed a factory unique in its construction and in the application of its motive power.

First Floor of Main Building—Room 1,000 Feet Long.

When complete the factory and offices will cover a floor space of 168,250 sq. ft., of which about 150,000 sq. ft. will be devoted entirely to the manufacture of the well-known Keating bicycle.

The factory is situated on the west bank of the Connecticut River, between the river itself and the Hartford-Middletown branch of the New York, New Haven and Hartford system. The establishment is divided into three buildings of brick and stone. The main building is 1,000 feet long, 50 feet wide and two stories high. Projecting from this on the river side are six L's, each of which is devoted to some special operation on the wheel. Reference to the plan shows the different departments which occupy these L's. The main L, 200 feet long, 50 feet wide and two stories high is the repair department and the store room. The others are respectively, the blacksmith shop, the brazing shop, the polishing shop, the plating shop, and the enameling shop, each of them about 100 ft. long and about 50 ft. wide.

View of Keating Factory, January 30, 1897.

President Tyler of the Southern New England Telephone Company has made a statement showing his institution to be in prosperous condition. They have 8,000 established stations and operate in 140 towns. The gross earnings for the fiscal year ending December 31 will be $550,000; the net earnings, $160,000.

The new stock has all been taken, and all but $97,000 of the $355,000 debenture bonds have been redeemed. Of the $630,000 in new stock issued, $630,000 was subscribed on or before the date set for closing the books.

President Tyler believes the company will earn $50,000 above the sum necessary to pay 6 per cent. dividends on the capital stock, which is now $2,500,000.—New Haven Register.

The Westinghouse Electric Company, encouraged by the volume of foreign business which it has lately been doing, has opened branches in Japan, Argentine, Chili and Mexico.—Philadelphia Times.

The north-east corner of the plot will be occupied by spacious offices, 100 ft. long by 50 ft. wide and two stories high, entirely separate from the factory and yet in sufficiently close touch to make it an integral part of the main factory building.

The unique feature of this factory lies in the fact that it will be entirely operated by electricity, not an engine or a main belt coming into the factory proper. The system chosen is the three-phase system of the General Electric Company, which is now in use in a large majority of power transmission and distribution plants in this country.

seen by the diagram of the building that the main shafting is about 800 feet long and runs down the central aisle, being divided into three sections, between each of which is a 50-H. P. G. E. induction motor of the inverted type. There are other shorter lines of shafting which are about 350 feet long, one on each side of the main shafting in the north part of the building. Still another line of shafting about 200 feet long runs through the repair department. The motors driving the shafting in the main building are two 50-H. P., while the line of shafting running through the repair shop is driven by a 20-H. P. motor, secured to the ceiling of the first floor in the main building.

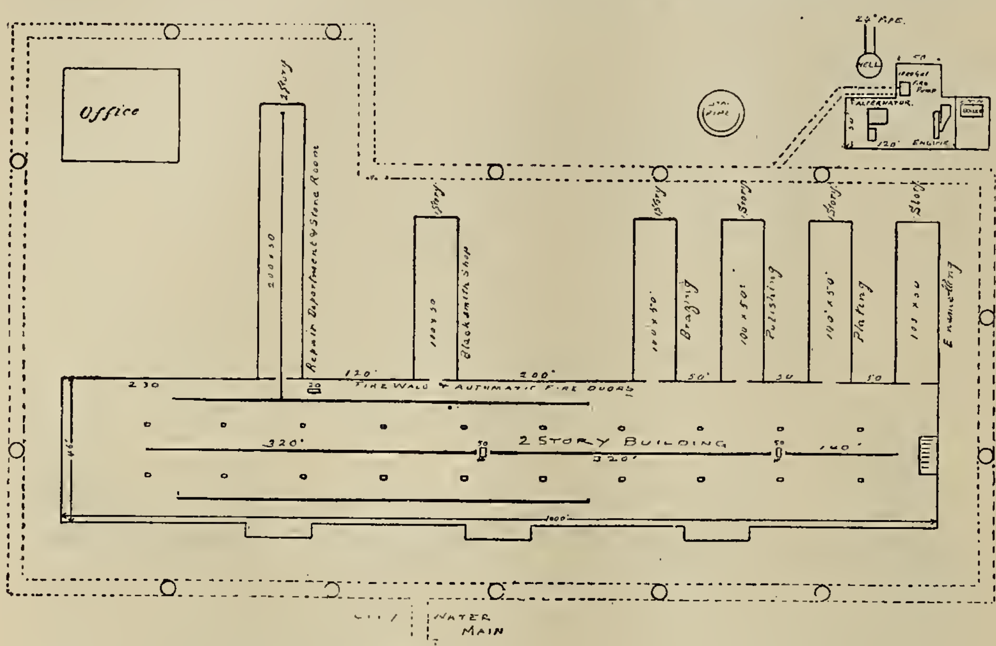


Fig. 1.—Layout of the Keating Factory at Middletown, Conn.

The engine and generating plant is located in the south-east corner of the plot in a two-story brick and stone building. Steam is generated by a Babcock & Wiloox boiler of 250 H. P., separated by a brick partition from the engine-room. The engine, a Cross compound-condensing Greene engine of 500 H. P., the high-pressure side only of which is installed, is erected upon the second floor, upon brick and stone cap piers built up from the ground. On the same floor is a General Electric three-phase generator, known as an A-T 16-pole, 250-kilowatt, 450-revolution, 60-cycle machine, also placed on piers carried up from the ground. The main belt from the engine and fly-wheel passes down to the ground floor where a countershaft runs in bearings set upon brick and stone piers. The shaft is carried the entire length of the room and from it will be driven eventually another three-phase machine, probably of similar capacity, as well as a set of lighting machines, to be erected at Middletown, as soon as they can be removed from the present factory of the Keating Wheel Co., at Holyoke. This countershaft is arranged with couplings so that any portion may be cut in or out as may be required.

The exciter for the generator is a 4½-kilowatt machine of the I. B. type, run from a pulley on the shaft of the three-phase machine. Facing the generator is a Vermont marble switchboard carrying packed cord rheostats, current indicator, voltmeter and the necessary switches for controlling the exciter and the generator. From the switchboard, six wires, forming two circuits, issue from one of the windows of the power-house and pass to the main factory, supported on one pole only. They are carried above one of the windows on the second floor of the factory and there three of the wires terminate, while the other three, which constitute the circuit in service, follow the centre of the roof of the second story for about three-fourths of the length of the whole building. At the proper place they are tapped off, descending their respective pillars and passing through the floor of the seeond story to the motors suspended from the ceiling of the first story.

The main building, 1,000 ft. long, is one great hall, supported on rows of pine pillars set ten feet apart. It will be

All of the motors are equipped with two pulleys on each end so that four independent shafts can be driven from each motor. The extent of this shafting and the method of driving the motors can be gathered from the illustration made from a photograph taken from one end of the main building. There is about 160 feet of shafting on the other side of the far motor shown in the pictures; this will give some idea of the extent of the installation.

There is no bicycle machinery in the factory at the present time, the construction work not being sufficiently advanced to enable the Keating Company to undertake its '97 production there. The 1897 wheels are being manufactured at Holyoke, and as soon as any piece of machinery can be dispensed with there, it will be shipped at once to Middletown.

The entire factory has been laid out by Mr. R. H. Keating himself, with all the care which a man can bestow upon a child of his own creation. It is protected from fire by a system of sprinklers located in the building. Furthermore, a water-pipe shown in the diagram surrounds the entire factory and is connected with an eight-inch city water main on one side of the building and with a 1,000-gallon fire-pump on the other. Into this water-pipe are let hydrants at intervals through which, should a fire occur in any part of the factory, water can be immediately turned upon it. The wall between the L's and the main factory is a fire wall fitted with fire doors automatically closing in case of conflagration.

In order that the factory should not be dependent entirely upon city water, Mr. Keating has sunk upon the side of the power-house nearest the river, a deep well into which water from the river runs through a 24-inch pipe. In addition a stand pipe will also be erected between the river and the main building.

The Keating Factory when in running order will be one of the most complete and modern cycle factories in the world. Nothing has been left to chance. It is the outcome of two years' close study and we may be excused if we say that the engineering talent which developed the "curve" in the bicycle diamond has found ample and sufficient scope in the magnificent factory which has been erected at Middletown.

THE MODERN POWER HOUSE.

RICHARD M'CULLOCH.

(Continued from Page 117.)

With condensing plants the waste from the condensers is never at a greater temperature than 100 degrees Fahr., and if hot feed-water is desired the use of an economizer becomes almost a matter of necessity as the water from the pumps and the other non-condensing machinery would not have sufficient effect in heating the feed-water of a large plant.

Several of the large power houses built during the last few years have abandoned the use of stacks for producing draught, and are operating by means of an induced draft produced by fans placed in the flue or short stack. In this case the stack is just high enough to clear the roof. This system has many advantages. First, there are no stacks to blow down or fall down, and this point is of special importance in a region subject to tornadoes. The second and most important advantage, however, is the absolute control which it affords in governing the fires, and this point will appeal especially to those power houses subject to sudden and rapidly changing loads. As an illustration of this may be cited the power house recently erected to operate the Baltimore tunnel road. A great part of the time there is no load on the power house as it is only operated when there is a freight train to he hauled through the tunnel. The manner in which the load is handled is as follows: The boiler room is supplied with blowers in place of stacks, and a slow fire is kept constantly under each boiler. When a telegram is received that a freight train is approaching, the blower is started and on the arrival of the train steam has been raised in sufficient quantity to supply the great demand put upon the boilers. This illustrated the extreme flexibility of the system and it would be difficult to handle this load in any other manner. Economizers are operated with great efficiency in connection with an induced draft as this system permits the flue gases to be robbed almost entirely of their heat, since it is not necessary to have a large quantity of heat in the flue gases in order to create a proper draft.

Passing from the steam generating system to the engines we find as a connecting link, the system of piping. In regard to the general plan of the piping, opinion is very much divided. Some favor a single-header with leaders to the engines. Others claim that a complete duplicate system is necessary, so that a failure in any part of the system need not cause a serious stoppage. The objection to a duplicate system is the greatly increased cost. In the installation of a duplicate system, it is only human that the material and workmanship employed will be cheaper than if a single system were employed, because it is reasoned that if one side breaks down there is always the other to be depended upon. The other side, however, is often never used until a case of necessity arises, and on account of this very lack of use, the valves and joints are apt to be found leaky and in bad condition when suddenly put in operation. A compromise system has been used is some cases in which all pipes are duplicated, each side, however, having only one-half the capacity required, necessitating the use of both side at all times. In case of accident to one side the other half of the system may be used, at a disadvantage, of course, by increasing the steam pressure. The best plan, however, seems to be to use a single-header divided at convenient intervals by valves according to the size of the plant and the number of units employed, and in laying out the system to use only the best valves, material and workmanship. The power houses having the least amount of trouble with their piping are those having a simple system, probably because it is natural to erect better, and take better care of something which is in constant use, than something which may easily be dispensed with. All steam and hot water pipes should be covered so as to prevent as much as possible loss of heat by radiation and consequent condensation of the steam. And in this connection it should be noted that there is a great difference in efficiency in the different kinds of pipe covering. Tests have shown that the magnesia, plastic and sectional coverings and the asbestos fire felt covering give the best results. (Journal of the Association of Engineering Societies, January, 1895). A water separator should be placed in the leader to each engine. It should be large in size and placed as close as possible to the engine. A number of patented separators are on the market, but very good results may be obtained by the use of a simple, large tank with the steam entering at the side and leaving at the top and supplied at the bottom with a connection to a steam trap to catch any water collecting in the separator.

STEAM CONSUMING APPARATUS.

The question of the selection of the proper engine to operate the plant is so dependent upon what dynamo is to be used, that it will be best to abandon our arbitrary classification temporarily and take up first the question of the dynamo. During the past four years the street railway generator has undergone a radical change. In the spring of 1893 there were installed in this city in the power house of the Cass Avenue and Fair Grounds Railway Company, then being built, the first large, direct driven generators of the type which has since become so common. Soon after this the Intramural power house at the World's Fair was put in operation, containing one generator of the same size as those in St. Louis, and another of twice the capacity. Since that time there have been few large power houses built in which direct-driven generators have not been installed, and some of the large railway system have found that economy of operation required a change from the belt, counter-shaft and unit of small size to the large direct-driven generator. At the present time The West End Railway Co. of Boston, which may be considered the pioneer in this country in electric traction, is changing its central power station, which had originally been equipped with a very complete and elaborate system of belting and counter-shafting to a direct coupled plan.

(To be continued.)

TALKING UNDER WATER.

Some time ago, in one of the daily papers, a story was printed to the effect that a Russian inventor had perfected a process by which a telephone line could be operated over a submarine cable. It was stated also that a large amount of capital had been secured and that in a short time telephonic connection would be established between New York and London. The story has been copied and reprinted quite generally, and there seems to be some popular idea that the report is authentic. Unless some new and remarkable discovery with regard to electric transmission of sound waves has been made, it may be doubted whether there is any truth whatever in the story, so far as concerns a telephone line between New York and London.

It may be true, as announced, that the Russian inventor has perfected a machine by which a telephone cable lying ten miles under water has been successfully operated; but in the matter of submarine telephone operation as the distance is increased arithmetically, the difficulties are increased in geometrical ratio. The obstacles which would be evident in operating a cable ten miles long would be about 65,000 times as great over the Atlantic cable, for example. Under these conditions it will be realized that the Russian inventor has a tremendous job before him.

It may be doubted also whether such a cable telephone

could be operated successfully from a financial standpoint, even if the mechanical difficulties were surmounted. The longer the distance of the line the larger must be the diameter of the copper wire making the circuit. In laying the cable of thick copper wire 2,600 miles, underneath the ocean, and in maintaining such a cable, there would be involved a very large expenditure account. It is at least doubtful whether a telephone line operated under such conditions could be made to pay its running expenses, even if no profit were to be considered.

Gas in London.—Although electric lighting has made giant strides during the last two years in London, it has not done much to displace gas. Edison once remarked to me that "Electricity is a ten-acre lot, and at present we are looking through the fence." And, although Edison has got through the fence, and Tesla and Lord Kelvin, not to mention many others, electricity has not yet put out gas. For, to a certain extent, the problem remains whether it is cheaper to burn coal or to burn copper. At all events London is not yet prepared to give up burning coal. The Board of Trade has just issued the figures relating to gas companies in London. There are five companies in this metropolis with a paid-up share capital of $66,865,445 and a loan capital of $19,877,495, a total of $86,742,940 invested in the commodity. These five companies supplied 423,696 private consumers and 81,580 public lamps through 3,258½ miles of mains—more than would stretch from New York to San Francisco. The total quantity of gas sold in 1895 was the almost non-comprehensible quantity of 30,474,256,000 cubic feet. It was sold for $26,822,495, and it cost to produce and deliver, $19,454,725. There was therefore, $7,369,570 with which to pay a profit on nearly eighty-seven millions of capital, about 10 per cent. on the stock.—N. Y. Mail and Express.

Alleged Infringement of Patent.—Trenton, N. J., Jan. 22.—Judge Acheson in the United States Circuit Court here today dismissed, with costs, the suit of the Shaw Electric Crane Company of New York against Henry R. Worthington, incorporated, of Elizabethport. The suit was brought by the Shaw Crane Company against the Worthington Company for the alleged infringement of patents on electric cranes. The case has been in the courts a long time.—North American, Philadelphia.

Pneumatic Car Fender.—Pneumatic car fenders have recently been patented, consisting of a number of elastic tubes set in metal frames shaped like ordinary fenders.—Philadelphia Record.

The Commissioners yesterday submitted to Congress a comparative statement of the cost of telephone service in this and other cities. In the last appropriation bill the Commissioners were directed to furnish Congress with such a statement, and they transmitted it without recommendation or comment. Rates in the following cities are shown: Washington, New York, Philadelphia, St. Louis, Boston, Brooklyn, Cincinnati, Chicago, Cleveland and Minneapolis. The service given the public in other cities being different in many respects to that given here, it is impossible to make a perfect comparison between the rates here and elsewhere.—Washington Post.

Viroqua, Wis.—O. C. Stevens may be addressed concerning lighting of Alms House with electricity. The electric wires connecting the asylum and county alms house have been put up and new engine and dynamo are here.

Plainfield, Wis.—An electric road will be constructed from Oshkosh, Winnebago County, through Waushara County to Stevens Point.

Bellows Falls, Vt.—Bellows Falls, Saxton River Electric Road; J. H. Holton says that the electric road will be constructed this summer.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—ECONOMICAL THERMO-ELECTRIC GENERATORS.

New York, Feb. 23, 1897.

Dear Sir:—The historical thermo-electric generators we read about so much seem to have fallen into disuse. I would like to know whether as a commercial article they can ever be a success, or if any forms at present exist of any consequence to users of current. Kindly answer an interested reader.

Herbert Eslie.

(A.)—Thermo-electric generators do exist of some commercial importance. A concern in England called the Cox Thermo-Electric Co. sell sizes of generators that depend upon the heat from gas for their operation. They are very convenient and supply quite a want in the market. The largest size gives ten volts and three amperes.

(Q.)—INSULATION RESISTANCE.

Newburg, Feb. 21, 1897.

To Electrical Age.

Dear Sirs:—A conductor carries current, an insulator presumably refuses to—is there therefore any other difference than that of degree between a good insulator and a poor conductor? It seems to me that starting from a very good conductor a list of materials mey be cited whose conductivity becomes less and less until a vacuum is reached. Is this the best insulator known?

Yours truly,
L. R. Mason

(A.)—The conducting power of different materials is measured by the standard of silver. A poor conductor with a high pressure applied acts like a good conductor with a low pressure. Therefore the difference is one of degree. An absolute vacuum is the best insulating medium known.

(Q.)—REDUCTION OF ORES.

Los Angeles, Feb. 18, 1897.

Dear Sirs:—The mining in the vicinity of this city is such that I think it provides a rich field for the engineer.

I am particularly interested in the application of electricity to the reduction of ores. Can you tell me whether the electrical and technical side of ore reduction is difficult to understand, and if it requires much electrical knowledge?

Yours truly,
Emile Barron.

(A.)—The electrical reduction of ore is, in my opinion, a simple process.

The methods employed either involve the fusion of the ore or the electrolytic purification of the crude metal.

Many details are to be known in order that a complete comprehension of the subject becomes possible. The reduction of aluminium and the methods employed in the Anaconda mine constitute examples. The latest volumes on metallurgy also contain descriptions of an interesting nature.

A hot fight is on at Hart between the Bell Telephone Co. and a local company organized some time ago. Citizens are standing by the local company, although the Bell has cut rates until they are considerably lower than the former's.—Detroit Free Press.

The Electrical Age.

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CONTENTS.

THE INCREASED SCOPE OF ELECTRIC POWER PLANTS.

Within the confines of the United States a development has occurred in the field of electrical engineering that has not had its equal in rapidity of growth in any other case on record.

The organization of the Edison and Westinghouse corporations was made with an object in view that today seems foreign to those early anticipations; and persuades us into belief that the natural development of an applied science prevents any particular branch of engineering from growing to the exclusion of the rest.

The present day, with its untold trolley systems and great power plants, seems wonderfully alive in comparison with the relatively sluggish advancement of the last ten years.

Advance in particular fields of work is usually slow, but after a certain period has been passed the progress made is almost proportional to the square of the time.

This is undoubtedly manifest in the unusual pace set by electrical workers in the civilized quarters of the globe.

It is particularly noticeable in the almost universal use of electrical equipments for traction and lighting. And in certain undeveloped fields there is also a certain expectation afloat, that the same marvellous progress will be an accompaniment to its commercial ripeness.

In one particular respect this electrical impetus has become strikingly apparent in the installation of large power plants in this country.

In recent issues of the Electrical Age the horse-power and character of such plants has been set forth and the conclusions noted. They seem to follow along these general lines:

That the great power plants of the near future will be polyphase.

That the limitations of distance are not a matter of the same serious consideration as before.

Present indications point to the universal dependence of groups of cities, towns and villages upon central sources of supply derived from the use of water power, consumption of coal at the mines or the use of natural agencies, such as the wind, tide or waves.

Considered not so very long ago as a luxury, the use of electricity for many purposes has passed that stage and is today regarded as a great necessity. All history points to the ultimate adoption of many so-called luxuries as necessities.

The greatest change will be that which will make us regard the introduction of electric light and power within the home as a necessary accessory to its modest joys; much the same as water and gas are looked upon today by the general public.

WORTH WHILE REALIZING.

The world contains two classes of men. One class believe and accept the latest innovations with perfect complacency. The other surrounds all new moves on the great dress of nature with as much of the mysterious as their time will allow. The Philadelphia Record makes note of the following in a very sensible manner.

A writer in one of the English electrical papers calls attention to the fact that people who are supposed to be well educated have not yet rid themselves of the erroneous idea that the force of electricity is not yet understood, that it is mysterious in all its actions, and moreover these actions cannot be accounted for by perfectly definite laws. An instance of this is given in the recent public address of a prominent English nobleman, who spoke of the divining rod for discovering water, and suggested that perhaps its action was of electric origin. It should be perfectly understood, the writer continues, that the laws of electricity are perfectly determinable, that there is no mystery about its actions and that its name should not be dragged into all sorts of gross frauds and impostures.

A $20,000,000 mortgage, given by the Commercial Cable Company to the Farmers' Loan and Trust Company of New York City, has been filed in the county clerk's office. It is a first mortgage, and covers all the property and franchises owned by the Postal Telegraph-Cable Company, which has recently been consolidated with the Commercial Cable Company. As the Postal Company owned property in this county it was necessary to file a copy of the mortgage here. The mortgage is not written by hand, but is a printed book of forty-two pages.—Syracuse Courier.

Winston, N. C.—The Fries Manufacturing and Power Co. has had plans prepared for the development of water power on the Yadkin River to be transmitted electrically to Winston.

Long Branch, N. J.—The Atlantic Highlands, Red Bank and Long Branch (N. J.) Electric Railway Company is negotiating for the purchase of mill property at Eatontown, with the intention of converting it into a power plant for supplying motive power for its trolley lines. The company intends to build a trolley line between Asbury Park and Freehold, in addition to the road it now operates between Long Branch and Bedford.

TELEGRAPH AND TELEPHONE LINES.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The Line.—The consideration of a line from certain standpoints makes the subject one of deep interest and importance to the earnest reader. A line is merely a conductor supported at frequent intervals by insulators. Its utility and efficiency depends entirely upon the excellence of these supports and its own conductivity. The material of the line merits the closest attention, and its resistance as compared with that of its supports provides a means of estimating the loss or gain by any specific change in either. Usually conductors are of either iron or copper for line work.

The insulators are usually of glass, although those used indoors are made of hard rubber. To give an idea of the extraordinary difference between a good conductor and an insulator a comparison made by Fleeming Jenkin might be recalled.

"The difference between a copper conductor and a gutta-percha insulator is about as great as the difference between the velocity of light and that of a body moving through one foot in 6,700 years." The following table gives a list of conductors in the order of their conducting power, also showing the decreasing insulating property of various materials:

Conductors.	Insulators.
Silver	Air
Copper	Glass
Zinc	Hard Rubber
Platinum	Shellac
Iron	Gutta-percha
Carbon	India Rubber
Acids	Porcelain
Salt Solution	Earth
Water	Ice
Wood (damp)	Oxides.

A copper conductor is used as a basis for estimating the resistanee of wires of other metals. In a table given by Franklin Leonard Pope a means of arriving at this fact by a simple calculation is shown:

For brass,	multiply copper resistance by	4.5
" German silver,	" " " "	12.9
" iron,	" " " "	5.9
" platinoid,	" " " "	19.5
" platinum,	" " " "	14.8

This valuable little table will prove very useful when wires of the same length and diameter are compared, and equally so should their diameters vary, because two wires of the same material and same length have a resistance inversely proportional to the square of their diameters. For such purposes a mil foot of each would show the desired relationship in an easy manner. A mil foot is one foot of the metal .001 of an inch in diameter.

The line in telegraphic practice is gradually being changed from galvanized iron wire to copper. This is an advantage in every respect, but means a heavy expense to the company. The leaks that occur from the line to the earth, due to the following—

Grounds,
Crosses,
Poor insulation,

are at times very bad, draining the system of its current and thereby destroying its effectiveness to a great extent.

The insulators may be covered with a film of rain water, the poles may decay and get soaked, and floating dust settling upon both insulator and line may provide a path to earth. In comparison with pure copper, clean rain water has 40,653,723 times the resistance. When mixed with foreign matter its conductivity greatly increases.

The earth in telegraphy acts as a return circuit; the extremities of the line being grounded by means of a large plate, either of copper or iron. This is set into the earth and from it the signals either extend forward or return through the instruments at each end. The earth, if very dry or sandy, will be a poor return circuit and the line suffer in consequence; therefore moist earth is the best material in which to ground the line. In a city the gas or water-pipe system is sufficient.

The resistance of an earth return is practically negligible, and is therefore lightly considered when tests are made.

Its specific resistance is very high, but the enormous cross section is ample enough to secure an almost complete reduction in resistance.

The ground plates, if made of copper, are about $\frac{1}{16}$-inch thick and about 4x4-feet in area. A galvanized iron plate is very much cheaper and just as serviceable. Contact is made with the connecting wire by soldering it, and the joint is protected by a non-corrosive substance from electrolysis and chemical action. If the soil is very dry a pit should be dug and the plate laid in it, surrounded by coke or charcoal, or other refuse equally applicable. A granitic district would probably develop some such a peculiarity.

Posts.—The poles will last long if their ends are creosoted or soaked in some silicic or protecting compound. In moist soil the decay quickly commences, and when aided by the burrowing of insects rapidly weakens the structure. A pole when wet falls quite considerably in resistance. As a rule the comparison is made between the resistance of the pole and that of the insulator and arm.

$$\frac{\text{resistance of pole}}{\text{resistance of arm} + \text{resistance of insulator.}}$$

This expresses the ratio between the two in a simple manner.

Cross-arms.—When the cross-arms of a pole are dry the resistance is about 100,000 ohms, but when wet this may fall as low as 4,000 ohms.

If left exposed to the air without even a coat of paint, the fall in resistance is very noticeable. The least resistance a cross-arm will have is about 1,000 ohms, that has not been absolutely soaked in water.

Treating the poles and arms to a preparation that does not absorb moisture would enhance the excellence of them as insulators quite considerably. The supporting power of a pole and its resistance in ohms are two entirely different and unproportionate qualifications, though they may bear a slight relation to each other.

Insulators.—The common form of insulator for line use is the single petticoat glass insulator so familiar to all. This is not a very excellent device for the purpose, as it is hydroscopic and brittle; but its cheapness and convenience make it a most popular article of use. The floating dust and begriming smoke soon impair their insulating property in a city or its suburbs. The maximum resistance per mile is about 60,000 to 100,000 ohms, depending upon the humidity of the air and their cleanliness. This may fall as low as 25,000 ohms per mile, if damp and dirty.

Varley, in his report to the Western Union Telegraph Co., states that the cleansing of insulators almost triples their resistance.

The improvement of a line depends greatly upon the insulators used, German porcelain are about the best. The glass insulator is about 5 megohms in resistance, while German porcelain insulators are over 15 and sometimes 20 megohms in resistance (1 megohm = 1,000,000

ohms). It is generally cheaper to improve the insulation of the line than to use a copper line. It costs about four times as much to increase the conductivity by the use of copper as to use new insulators of high resistance.

The ratio between the conductivity of the line and that of the insulators is 1 : 10,000 with a No. 9 iron wire (Pope) of 15 ohms per mile, mounted on glass insulators of 4.5 megohms a piece, and 30 poles to the mile. This is generally about the average condition of a line, and any increase in this ratio means a gain in current.

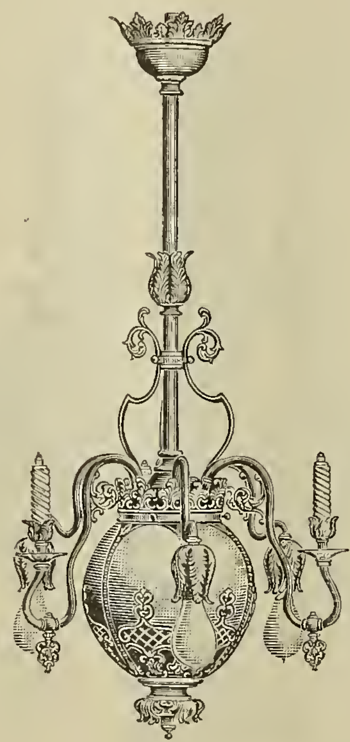
—The following out-of-town visitors were registered at headquarters of the National Electric Light Association, 136 Liberty street, for the week ending February 11.

S. G. Booker, St. Louis, Mo.
Jas. I. Ayer, Boston, Mass.
F. S. Terry, Chicago, Ill.
W. C. Bryant, Bridgeport, Conn.
F. Z. McGuire, London, Eng.
T. H. Brady, New Britain, Conn.
F. A. Gilbert, Boston, Mass.
E. B. Hatch, Hartford, Conn.
J. H. Rhotehamel, St. Louis.

W. C. VOSBURGH MFG. CO., LIMITED.

269 to 281 State street, Brooklyn, N. Y.
114 and 116 Wabash avenue, Chicago, Ill.

It gives us pleasure to bring to the attention of our readers in this issue the establishment of the W. C. Vosburgh Mfg. Co., Limited, by illustrating below a cut showing the factory and warerooms of this concern which are located at Brooklyn, N. Y. The concern has also a branch warehouse at 114 and 116 Wabash avenue, Chicago,



Vosburgh Fixture.

Ill., from which the trade is supplied in the west, north and southwest.

The plant of this company is one of the largest in the country and is given up entirely to the manufacture of gas, electric and combination fixtures for lighting purposes, and is fully equipped with all modern and improved

W. C. Vosburgh Mfg. Co.'s Factory.

machinery for the making of this class of goods. The goods manufactured by this concern are noted for originality of design and high standard of workmanship and finish. The principal outlet for same is to and through the dealers, who appreciate well-made goods and who the W. C. Vosburgh Mfg. Co., Limited, make it a point to

protect in any and all sales made by them at retail to consumers.

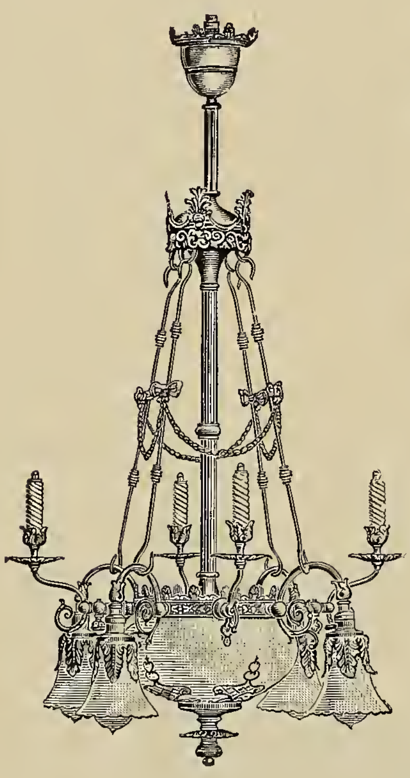
Among some of the many places recently furnished with high-class goods by this company might be mentioned the following: The Central M. E. Church, Oskaloosa, Iowa; First Presbyterian Church, Winona, Minn.; Masonic Temple, Logansport, Ind.; Wayne St. M. E. Church, Fort Wayne, Ind.; Irving Savings Bank, New York City, N. Y.; City Hall, Brooklyn, N. Y., and Mr. W. E. English's new residence at Indianapolis, Ind. To any of the above the W. C. Vosburgh Mfg. Co., Limited, has no hesitancy in referring for quality and class of goods and workmanship.

Among some contracts recently taken by this company and upon the fixtures for which they are now at work are the following: A number of buildings for the Hon. W. H. Reynolds; the City Building, Parkersburg, W. Va.; the new building of the Title Guarantee and Trust Co., and the Manufacturers' Trust Co., the last two being in Brooklyn. Space prevents enumerating many others that attention might well be called to.

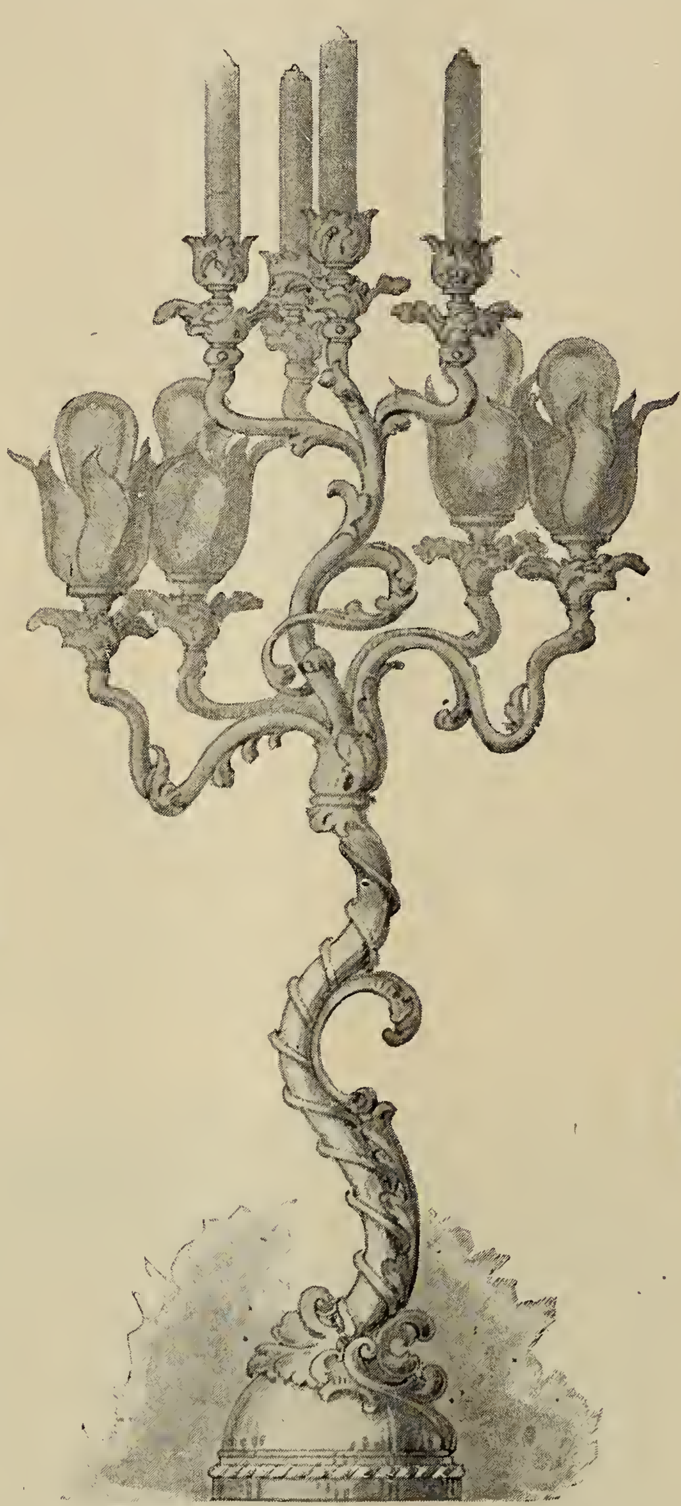
There is one thing that we must not fail to mention, and that is that dealers who are practical men and who have once handled the goods as made by the W. C. Vosburgh Mfg. Co., Limited, are ever after permanent customers because they get well-made goods and prompt and courteous business treatment.

We illustrate also a few of new and popular designs recently gotten up by this concern, and for beauty of design and first-class workmanship would call attention to the Newel-light in the Rococo style, made for use with both gas and electricity. This was recently placed in the new Montauk Theatre, of Brooklyn, the entire house being furnished with goods of same style.

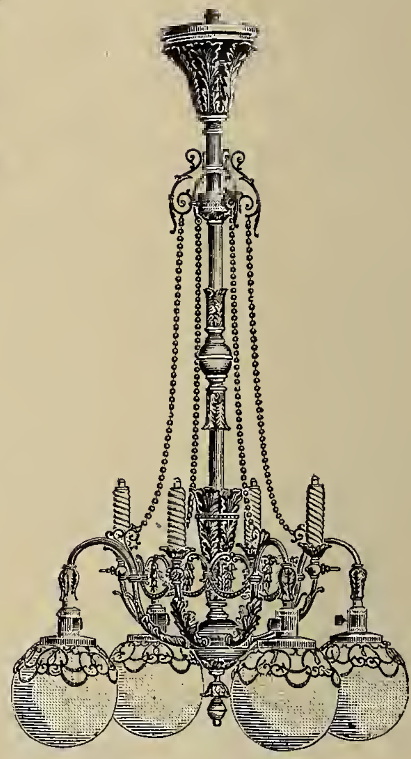
We do not hesitate to say to the dealer or electrician who has not as yet had goods of this company's make, that it would be to their interest to call on them, either in Chicago or Brooklyn, give them a trial order and you will thereafter not want to handle any other make of goods.



Gas and Electric Chandelier.



Newel Light, Rococo Style Combination Fixture.



Gas and Electric Chandelier.

NEW YORK ELECTRICAL SOCIETY.

The 180th meeting of the society was held at Columbia University, Madison avenue and 49th street, on Wednesday, February 24, at 8 P. M.

Mr. Willard E. Case delivered a lecture on "Electricity From Carbon Without Heat."

Special importance attaches to this lecture at the present time, when so many advances and ideas are being brought to notice by inventors. Mr. Case has long been an experimenter in this field, and has a great deal of interesting and valuable data, which will be appreciated by electrical engineers and students.

Mr. Case prepared for the occasion a variety of apparatus to illustrate types and principles.

George H. Guy, Secretary.

South Paris, Me.—South Paris Board of Trade may be addressed concerning electric light plant.

THE SCOTT FOCUSSING LAMP.

The illustration depicts the general construction of the Scott automatic focussing lamp, manufactured by the Scott Electric Lamp Co., No. 126 Liberty street, New York. A very laudatory criticism of the lamp, taken from Wilson's Photographic Magazine, is to be found in the form of a printed circular distributed by the Scott Company.

The difficulties of adjustment are absent in this special construction and all the good qualities of the lamp stand forth prominently.

The steadiness with which they burn and the absence of noise makes it very eligible to a position of popularity among consumers. The photographer and engraver will find in the Scott lamp a balm that will soothe the many pains, the irregularities of other focussing lamps may have caused.

Scott Focussing Lamp.

Among the many using this lamp are:

G. G. Rockwood, New York City.
W. Kurtz, New York City.
The Gill Engraving Co., New York City.
The Moss Engraving Co., New York City.
Central Bureau of Engraving, New York City.
Electro Light Engraving Co., New York City.
Hopkins & Blaut, New York City.
Pennsylvania Railroad Co., Altoona.
Marcus Ward Co., Belfast.
Electro Tint Co., Philadelphia.
The Hub Engraving Co., Boston.
Post-Express, Rochester.
The Courier, Buffalo.
Rockwood Solar Printing Co., New York City.

A NATIONAL UNIVERSITY.

(Continued from page 126.)

There is, perhaps, a more serious question as to whether the representatives of the people at Washington are competent to manage a university. Might they not regard it as part of the spoils of victory? We think the risk is slight and transient. The Smithsonian Institution and the Military Academy at West Point have not become involved in practical politics, and the state universities have in nearly all cases not only remained non-partisan, but have set a salutary example to other departments. A national university should not offer patronage and high salaries, but permanency of office, the most perfect facilities for research and publication, the ablest students to teach and the best intellectcal environment. It would by its own nature be self-conservative. A national university would not only be, in all probability, itself free from political influences, but would tend to preserve the scientific bureaus from these and to purify and elevate all offices under the government.

It may be said that our existing universities supply the need and that a new university would interfere with these. This was not the opinion of the heads of Cornell, Pennsylvania and Stanford Universities, who have been among the ablest and wisest advocates of a national university. The growth of the University of Berlin has not weakened the other German universities. A great national university would be the head of our educational system. It would not interfere with existing universities any more than these interfere with our colleges or our colleges with our schools. Our present universities consist chiefly of professional schools, on the one hand, and of colleges for

the instruction of boys, on the other. They are, indeed, developing toward true universities, but nothing could better hasten and direct this development than a national university.

From a theoretical point of view it would seem that all the arguments which have been urged against the establishment of a national university turn out to be in its favor. The cost, the incompetence of government and the claim that existing universities suffice are, however' practical difficulties which we do not underestimate. Indeed, these are so evident that that we should regard it as useless to advocate the immediate establishment of a great national university. We rather hope for a gradual growth from the national institutions already existing at Washington.

We have there great libraries, museums and laboratories, able investigators engaged in advancing pure and applied science, and younger men learning from them the methods of research. These are the essentials of a university. No university in the world includes so many or such able investigators, teachers and students of geology as the United States Geological Survey, and in many departments the work at Washington surpasses any American university in the amount of investigation accomplished and in the number of investigators trained.

We should recommend the development of the Bureau of Education somewhat in the direction of the University of the State of New York. Let it have power to regulate academic degrees and to confer them. Degrees may belong to an immature civilization, but this is just the kind of civilization of which we must make the best. Workers in the different government divisions and others having the proper preliminary education could, on presenting a thesis showing original work and passing an examination, receive the doctorate of philosophy, and this would qualify them as a civil service examination for promotion. The present Commissioner of Education, and perhaps the regents of the Smithsonian Institution, could govern the university. Examiners could be appointed from leading representatives of science and learning who would meet yearly for a week of convocation in Washington. We believe that, without radical changes and with nominal expense, there could be established at Washington a national university likely to become the world's greatest university.—Science.

POSSIBLE CONTRACTS.

DeValla Bluff, Ark.—An electric light plant is to be established immediately.

Newton, Mass.—City Clerk may give information concerning proposed erection of electric light plant.

Fremont, Mich.—A municipal electric light plant is to be established in the spring. City Clerk may give further particulars.

Port Huron, Mich.—The City Electric Railway will erect a plant of its own.

Chicopee Falls, Mass.—A large number of Falls residents have put in circulation a petition to the Springfield Street Railway Co., asking for an extension of the St. James line to the Falls.

Beaver Falls, Pa.—Frank R. Pearson is at the head of a company which is being formed to harness the waters of the Beaver River, at Beaver Falls, for the purpose of manufacturing electricity.

Brockton, Mass.—An electric road will probably be constructed from this city to East Bridgewater.

Pelham, N. H.—A bill is before the New Hampshire legislature to charter an electric railroad from the state line in Dracut to Derry, N. H.

BEACON LAMP CO.

The Beacon Lamp Co., of New Brunswick, N. J., manufacturers of incandescent lamps and Crookes tubes have lately opened up a fine suite of offiees on the 9th floor of the fine new building, No. 120 Liberty street, N. Y. Mr. W. Armitage, the manager of the N. Y. office, is a very energetic and progressive business man. Great credit is due him for the excellent management of the company's affairs in this locality. Lamps of every pressure, as high even as 300 volts, are manufactured by the Beacon Lamp Co. The great reputation of this lamp has made its name a familiar by-word to buyers and consumers all over the United States.

KINSMAN & KNUDSON.

A new firm called Kinsman & Knudson has been established. The partners are supervising and consulting electrical engineers. They make expert investigations and reports on all of electrical enterprises. Their address is Manhattan Life Insurance Building, No. 66 Broadway. Mr. Kinsman was the originator of the old Electrical Construction and Supply Co., the concern that gave the Ward lamp such prominence. Mr. Knudson invented the K. K. wire, a most familiar make to the trade.

A VALUABLE CONTRACT.

W. C. Ballda, manager of the Utica Electrical Manufacturing and Supply Company, closed a contract with the Walcott & Campbell Spinning Company, of New York Mills, for a complete modern lighting plant for their new yarn mill. The installation will consist of an 800-light Eddy incandescent dynamo, forty-five of the celebrated Manhattan 150-hour enclosed arc lamps, and 262 Buckeye incandescent lamps, together with switchboard.

(Copy of clipping from the Utica Sunday Journal).

AMERICAN ELECTRICAL WORKS.

The American Electrical Works, of Providence, R. I., have proved their loyalty and patriotism by distributing among the trade souvenirs of Washington's Birthday.

The "Father of His Country" is depicted in one of them contemplating a fallen cherry tree. This story has its moral; it illustrates the overthrow of British rule by the broadaxe of American independence.

George Washington did justice to his country and himself in not denying this allegorical tale. His expression, though immature, is that of stern pity and self-consciousness.

It has been the pride of American people to admire it ever since.

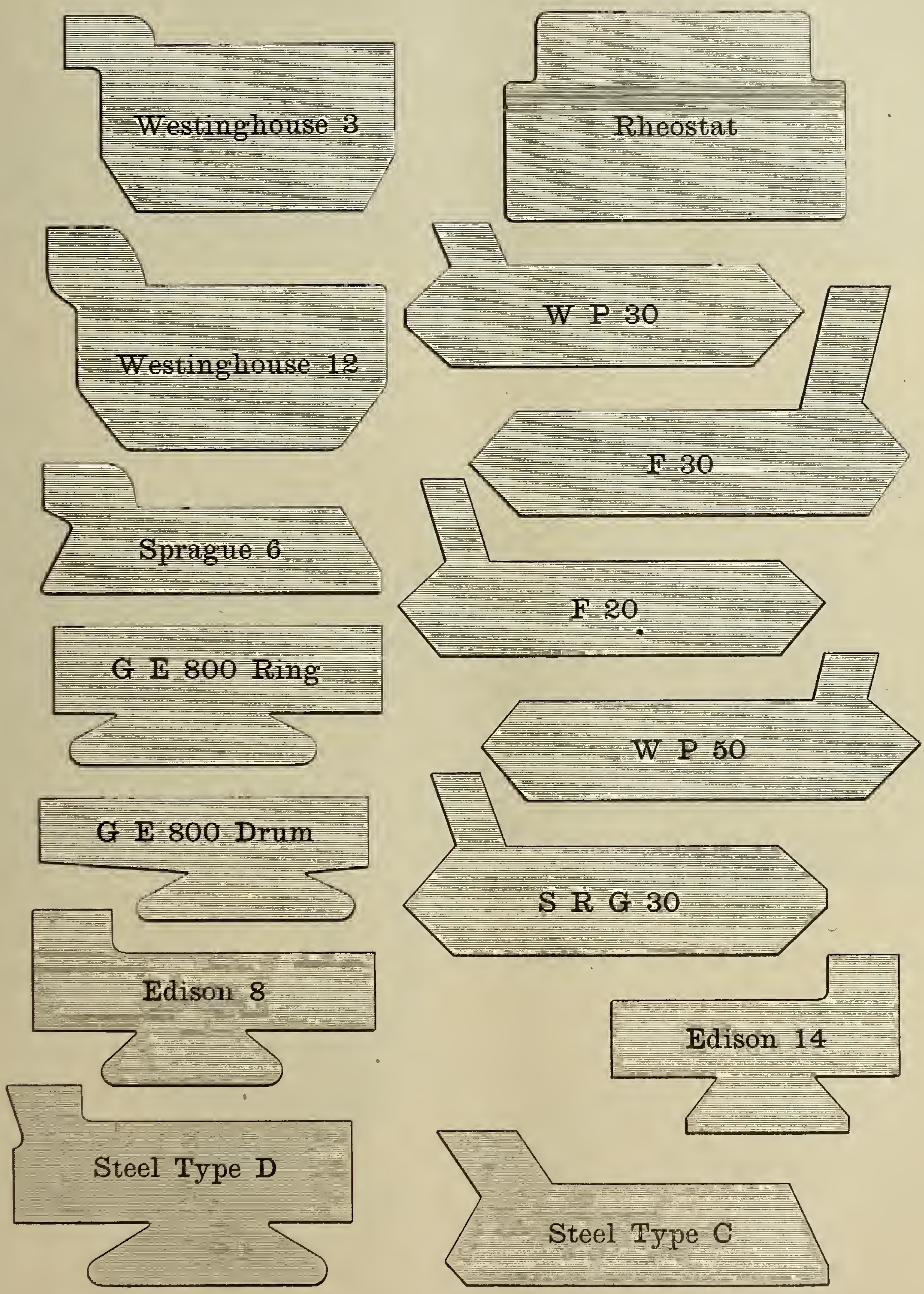
The other souvenir is from a very fine steel engraving, giving a medallion-shaped impression of Washington's head. It is a worthy memento and fit for framing.

This testimonial to Washington will likewise advise the public that the largest makers of bare and insulated electric wires and cables are the American Electrical Works. Their offices in New York are 10 Cortlandt street; Chicago, 241 Madison street; Montreal, Eugene F. Phillips' Electrical Works, Limited; Phillipsdale, R. I., main offices and factories.

Rochester, N. Y.—Citizens' Light and Power Co. will hold meeting of stockholders at office of company, 39 Market street, on February 26, for purpose of considering the matter of increasing the capital stock of the corporation from $150,000 to $400,000. If the capital stock is increased the company will enlarge its plant and bid for street lighting.

MICA.

The manufacturers of electrical goods find the use of mica indispensable in every case. The most common method of utilizing it is in connection with the commutator of a dynamo. In order that the results obtained may to all other similar products. The largest concerns make use of Mr. A. O. Schoonmaker's mica, who is an importer of the East India article. His address is 158 William street, New York. The mica is cut to sizes, as per illustrations, and is supplied of various grades according to the consumer's option. Mr. Schoonmaker carries many solid



Mica Segments.

be satisfactory it is necessary to use good mica that has not been tampered with but which retains its natural and therefore valuable properties of insulation. Mined in the heart of India, the mica is of unaffected purity and comes from the best source in the world. Uniform in its thickness of laminea and free from iron it then may claim superiority sheet mica segments in stock and his promptness in filling orders can be tested at any time.

Segments built up and gauged to various thicknesses are also in his line. He will supply all demands in the line of mica with the greatest satisfaction to customers.

CANADIAN LETTER.

Chatham, Ont.—The promoters of the proposed Chatham City and Suburban Electric Railway will apply to council for an extension of their franchise to include electric lighting.

Niagara Falls South, Ont.—A. G. Hanan and Ed. Davis, of Niagara Falls, have secured the control of the Niagara Falls, Clifton and Drummond Street Railway and will probably convert it into an electrical system in the spring.

Rossland, B. C.—A company of eastern capitalists have been formed to construct an electric railway between this place and Spokane, a distance of 160 miles. It is likely that the Rossland will be built this year, but steps will be taken at once to build that portion of the line from Spokane to the boundary line.

Hamilton, Ont.—The International Radial Railway Co. will make an application for a bonus of $65,000 towards the construction of an electric railway to Guelph.

NEW CORPORATIONS.

New York, N. Y.—New Power and Light Co., of New York and Brooklyn, has been incorporated by B. F. De Freece, T. C. Hunt and M. J. Katz. Capital stock, $100,000.

Hatboro, Pa.—Hatboro Electric Light Co. has been incorporated, with a capital stock of $20,000.

New York, N. Y.—The Rockaway Electric Railway Co. has been incorporated by Remington Vernon, Joseph McLean, Geo. F. Keller, Cornelius Connelly, Theodore Bernard and others; to construct a double track street surface railroad about four miles in length. Capital stock, $250,000.

Buffalo, N. Y.—The Proctor Raymond Manufacturing Co. has been incorporated by Charles H. Proctor, Nelson H. Raymond and H. H. Fink; to manufacture electrical and hardware supplies and appliances. Capital stock, $30,000.

Milford, Pa.—The Milford Electric Light and Power Co. has been incorporated, with a capital stock of $10,000.

NEW TELEPHONE COMPANIES.

Cuero, Tex.—The Gulf Coast Telephone Co. has been incorporated, with a capital stock of $10,000.

Brookfield, Mass.—The Warren, Brookfield and Spencer Street Railway Co. have applied for franchise for an electric railway in the public street from the North Brookfield branch railroad crossing at East Brookfield to the North Brookfield town line.

Rutland, Vt.—City Clerk may give information concerning establishmeut of a municipal light plant.

Frederick, Md.—The Myersville and Catoctin Railway Co., Reno S. Harp, secretary, will build a power plant to supply electricity for its railway.

Charleston, S. C.—The Charleston Street Railway Co., recently reported as to erect a power house, will also put in an equipment for supplying the city with electric lights. The entire improvements will probably cost about $1,000,000.

Dallas, Tex.—T. L. Lawhon, city secretary, may give information concerning proposed erection of electric light plant.

ELECTRIC STOCK QUOTATIONS.

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	35	38
Eddy Electric Mfg. Company,	—	19
Edison Illg. Co. (St. Louis),	1	2
*Edison Elec. Illg. Co., New York,	104½	105½
Edison Elec. Illg. Co., Brooklyn,	96½	97½
Edison Ore Milling Co.,	7	10
Edison Elec. Storage Company,	28	29
East End Electric Light	—	10
Fort Wayne Electric Company,	½	1
Ft. Wayne Elec. Co. T. Sec. Series A,	3	3½
General Electric Company,	34½	34⅞
General Electric Company pf.,	74	76
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	81½	82
Rhode Island Elec. Protec. Co.,	110	122
Toronto (Canada) Elec. Light Co.,	125	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4
Thomson-Houston Welding Co.,	5	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse El. & Mfg. Co., pf.,	50½	50¾
Westinghouse El. & Mfg. Co., assd.,	24¼	25½

*Ex dividend.

The Electrical Age.

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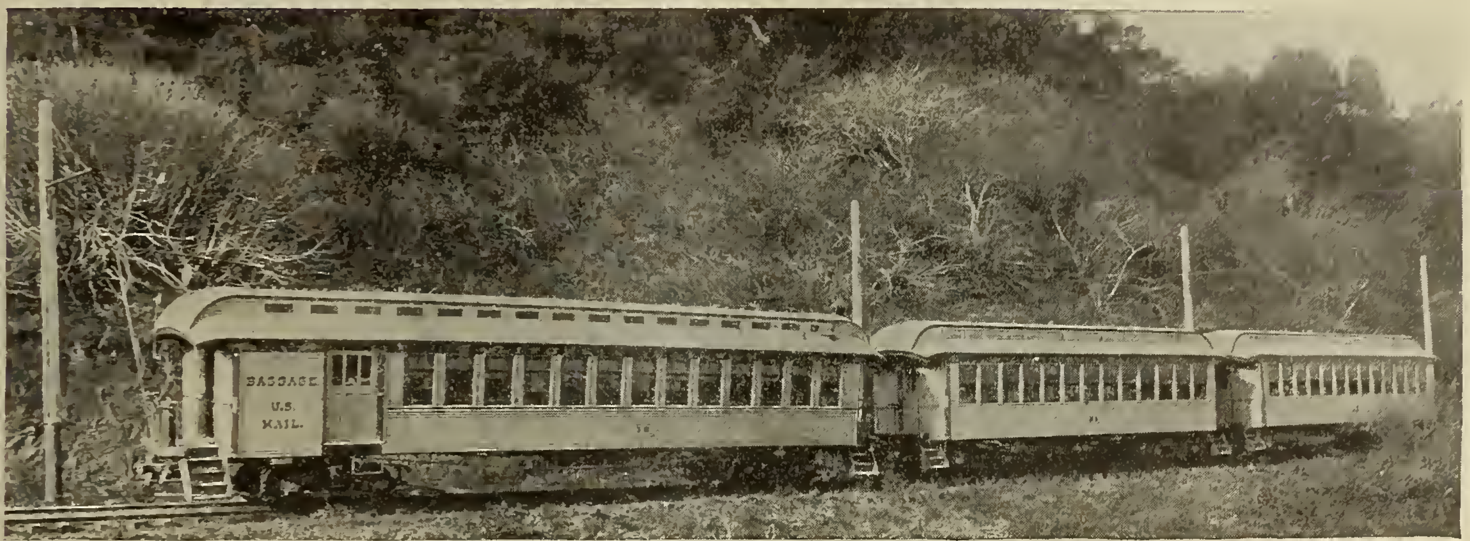
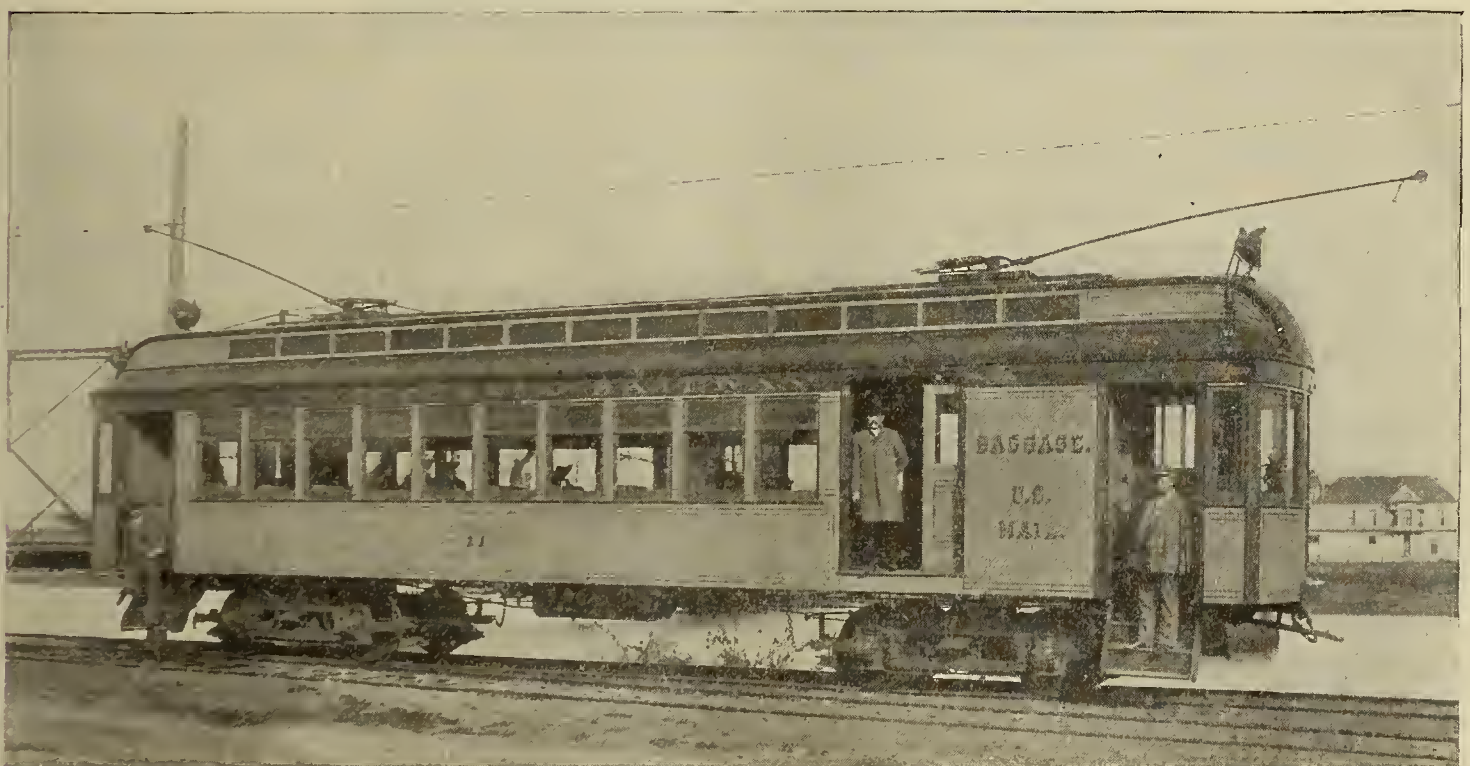


Train of Cars Electrically Equipped.



Electric Locomotive and Passenger Car Combined.

FROM STEAM TO ELECTRIC ROADS.

It is not alone in the East that the application of the electric motor to steam line traction has been favorably considered and adapted, and while our attention is concentrated upon the improvements effected and contemplated upon such important roads as the New York, New Haven and Hartford Railroad and the Baltimore and Ohio Railroad, similar action in the far West is apt to be overlooked. Yet a very interesting adaptation of the electric motor to the steam car has recently been made on a railroad in California.

The California Railroad Company operates a short line of road, some three miles in length, which runs from the junction of the Southern Pacific Railroad to Leona Heights, passing on the way Mills Seminary, the California equivalent of Vassar College. The road serves Alameda and Fruitvale, which are both located just across San Francisco Bay, opposite San Francisco itself.

The cars used are standard steam railroad cars. The motor cars of the train, of which one is shown run out for the purpose of being photographed, are composite baggage and passenger cars. Motor car No. 11 is vestibuled at each end and carries on each hood an electric headlight. It takes current from an overhead wire by two trolleys, one of which only is in contact during operation. Each motor car is fitted with an automatic air-pump to operate the brakes and the chime whistles, of which there are two, one on each hood.

The motor equipments consist of four G. E. 1,000 motors, two mounted upon each truck.

The controllers are of the K type and are provided, of course, with a magnetic blow-out. Each car is provided with automatic circuit breakers and resistances, and the interior is lighted by incandescent lamps in groups of three. The illustration shows the interior of car No. 11, showing the position of the controller and the motorman as seen through the door of the baggage compartment.

Motor car No. 21, which is shown coupled to its train,

is also a composite car and is similarly equipped so far as its electrical apparatus is concerned. It is not vestibuled, however, and was one of the first to receive its electrical equipment.

The track is of standard steam railroad construction for the return. The overhead line is suspended from iron brackets swung from round poles for part of the way; for the remainder of the distance it is suspended from span wires.

Interior of Electric Passenger Car.

The general character of the equipment of this road is similar to that in operation on the New York, New Haven and Hartford, with the exception of the motors, and it will be recalled that the cars of this latter line and their equipment served as models, both in the design of the car itself and the arrangements of the motors, for the locomotives designed by the late D. L. Barnes.

The General Electric Company, which carried out the equipment of the California Railway Co. through its Pacific coast office, will equip another locomotive for use on the Alameda and Fruitvale line, using, however, two or four G. E. 2,000 motors instead of G. E. 1,000 motors, as on the other cars. This new locomotive will shortly be completed, when we hope to be able to present a picture of it for the benefit of our readers.

Though rather late, we take pleasure in publishing the following note from the Newark Call: "The class in Electricity at the Evening High School was given a treat on Thursday evening. Under the direction of Professor Sonn, it visited the Cooper store in New York and inspected the electric plant there. The plant is under the charge of Gustave Voigt, a graduate of the Newark High School and of Lafayette College. Mr. Voigt gave up two hours of his time to the visitors, and explained the workings of the electric lighting system in use at the big store, and gave the boys much practical information. Such trips as this do the pupils more good than many hours of text-book work."

The National Conduit Manufacturing Company secured the order for 750,000 feet of their popular cement-lined conduit for the Metropolitan Traction Company.

J. L. Chapin, No. 50 East 20th street, New York, electrical engineer and contractor, has installed some of the finest electric light plants in this section of the country.

The St. Andoche Apartment House, located on an eminence at West End avenue and 102d street, one of the most elevated points in the city, Mrs. Maggie Mitchell Abbot owner, was equipped by Mr. Chapin. The plant includes electric light, electric elevator, and even ironing devices; also bells, wiring, gas and electric fixtures.

TELEPHONING ACROSS THE OCEAN.

Thomos A. Edison gives his views in the Herald on the subject so fascinating to inventors—speed across the Atlantic—in the following extract. We credit the Inventive Age with priority of publication:

"If you were backed by a ten-million dollar syndicate, would you undertake to construct a practical working telephone across the Atlantic Ocean?"

"It is impossible," he replied.

"There is a Russian who has telephoned under ten miles of water, and who claims that he can easily telephone across the Atlantic Ocean. He is being backed by a syndicate, and it is said that work will shortly be commenced on a submarine telephone cable."

Without a word Mr. Edison picked up a pad of paper and began to figure and talk.

"The difficulty of telephony increases according to the square root of the distance. He telephoned ten miles under water, did he? Well, he must have had some little trouble. At ten miles his difficulties would be four. Then they would run up as follows:

At 40 miles	16 times as hard.
At 80 miles	64 times as hard.
At 160 miles	256 times as hard.
At 320 miles	1,024 times as hard.
At 640 miles	4,096 times as hard.
At 1,280 miles	16,384 times as hard.
At 2,560 miles	65,536 times as hard.

"This is about the distance across the Atlantic Ocean. Now, if that Russian can overcome a job 65,000 times as hard as telephoning under ten miles of water, he may possibly telephone across the Atlantic Ocean. It is not a question of battery, but of leakage and the overcoming of resistance and the impossibility of getting rid of the current at the moment the voice ceases. Such a distance, especially such a submarine distance, affords entirely too clumsy a channel for the quick and variable current necessary to a telephone wire. As I said before, it is not a question of battery. Why, with the battery now on the Atlantic cable I can run a fan motor at either end. At the same time the speed of the motor could not be varied quickly enough to make its starting and stopping a matter of a few seconds. Taking these things into consideration, I am afraid the eminent Russian has a heavy job ahead of him.

"If I could erect poles three miles high I would undertake to telephone around the earth. As you approach the earth, however, the difficulties increase greatly, and they are of such a nature that I am afraid they can never be overcome—at least, not with present human intelligence."

CONDUCTIVITY OF INCANDESCENT CARBON FILAMENTS, AND OF THE SPACE SURROUNDING THEM.*

BY JOHN W. HOWELL.

THE first part of this paper, which relates to the conductivity of carbon filaments, is in the nature of a discussion of a paper read before the institute by Prof. Anthony, at the May meeting in 1887.

Prof. Anthony spoke of a change from negative to positive of the temperature coefficient of some carbon filaments which he had observed. He illustrated the change by a figure, which I will reproduce here for reference.

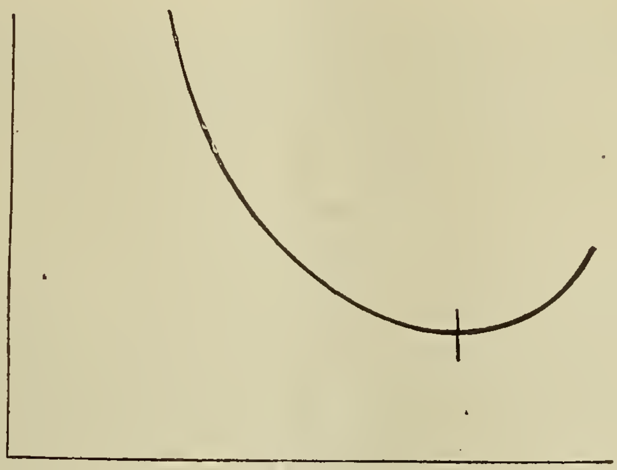


FIG. 1.

Prof. Anthony stated that this change did not occur in all filaments, and that he was unable to explain the circumstances under which it did occur.

Prof. Elihu Thomson, in his discussion of Prof. Anthony's paper, said that he had observed the same phenomenon, but had not investigated it sufficiently to explain its cause.

About four years ago an inventor offered to the General Electric Company a method of coating carbon filaments with metal, claiming thereby a very great improvement in the performance of the filaments. The metallic coating was applied by heating the filament to high incandescence in the presence of the vapor which was obtained from a very thick dark colored liquid, the application being made by the same means as is employed in the ordinary hydrocarbon flashing process. The proof which he gave that his filaments had a metallic coating was the fact that the resistance of these filaments was lower at about red heat than it was at higher temperatures.

In order to test his assertions, I treated a number of filaments with his dark liquid, and, for a comparison, treated in exactly a similar manner a number of similar filaments, using ordinary gasolene. To the surprise of both of us, the gasolene filaments showed the same rise in resistance, after passing the dull red temperature, as was shown by the filaments supposed to have a metal coating. This fact led me to investigate this phenomenon.

I had previously made resistance curves of a great many Edison lamps, which had filaments made without hydrocarbon flashing, and I knew that the filaments of all these lamps continued to fall in resistance to the highest temperature which they would stand. As we had very recently adopted the hydrocarbon treatment upon our filaments, I associated the change in the resistance curve with treated filaments. The filaments which I have previously described as having the reverse curve, were quite heavily treated. I now made a set of ten lamps with various amounts of treatment, all made from similar base filaments. These lamps had filaments the resistance of which, when cold, were 90, 80, 70, 60, 50, 40, 30, 20 and 10 per cent. of the cold resistance of the original base.

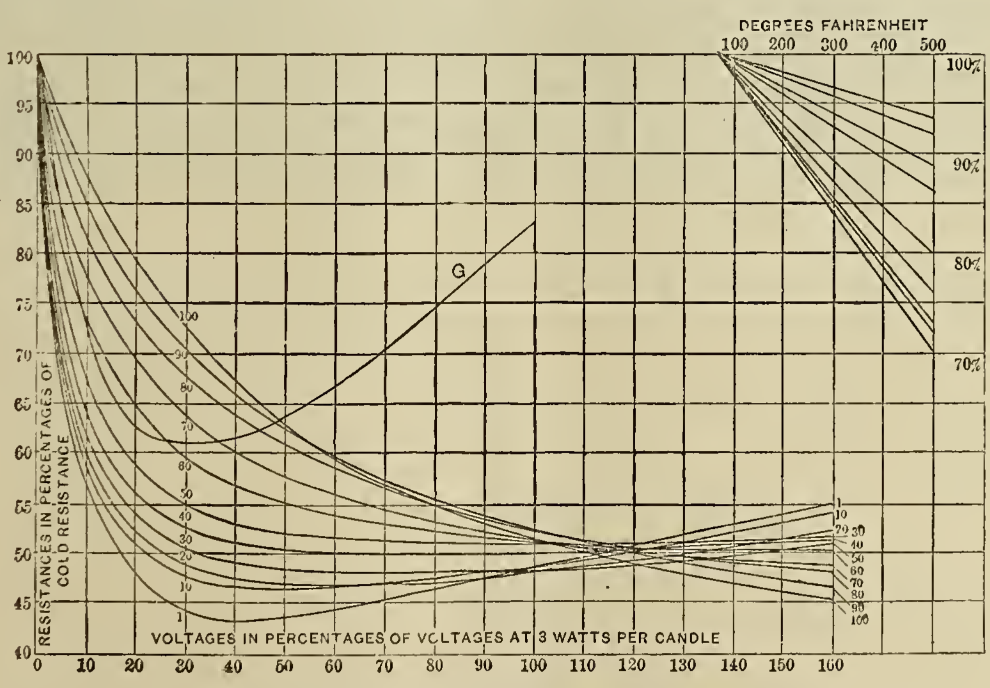


FIG. 2.—Curves showing changes of Resistances of Lamp Filaments with Voltage and Temperature.

I found upon plotting the curves of these filaments, that the untreated filament fell in resistance as it was made hotter, and that this fall continued to the highest temperature at which I dared run it.

*A paper presented at the 112th General Meeting of the American Institute of Electrical Engineers, New York, February 17th, and Chicago, February 24th, 1897.

The slightly treated filament fell in resistance more rapidly than the untreated filament at first, and less rapidly as the high temperatures were reached, its curve finally rising above that of the untreated filament. As the amount of treatment is increased, the curve falls more and more rapidly at first, and less rapidly at the higher temperatures. When we reach the filament treated to 50 per cent., we find that it falls rapidly to about 50 per cent. of its cold resistance, and remains practically constant at higher temperatures. The curves of filaments treated to less than 50 per cent. all rise after reaching their lowest point, which is reached at about 50 per cent. of their three watts per candle voltage.

These curves show the changes in resistance of these filaments. The ordinates are percentages of the cold resistances of the various filaments, so that all curves start from the 100 per cent. mark. The abscissæ are percentages of the voltages at which the various lamps take three watts per candle. The bottom curve on this sheet illustrates the resistance curve of a carbon filament which had been treated to about one per cent. of its original resistance. This made a filament which was nearly all treatment. This curve shows an increase in resistance from its lowest point to the last point obtained, of about 25 per cent.

This lamp was measured at the Edison Laboratory by Mr. Kennelly and myself. The readings were very carefully taken upon very sensitive instruments, and there can be no doubt as to the accuracy of the curve, as it agreed very well with the measurements I had previously made upon the same filaments. These curves can be obtained a good many times from the same filaments, so there is no permanent change in the filaments which in any way accounts for the rise in resistance. The cold resistance of the filaments, after being measured, were found to be the same as before any measurements were made.

These same ten carbons were taken from the lamps and put into a baking oven, the temperature of which could be regulated very nicely by an electric heater. These filaments were heated to about 500 degrees Fahr., the temperature being measured by two mercury thermometers. The resistance curves obtained in this way are shown on the upper part of the sheet, and agree quite well in character with the resistance curves obtained by measuring the volts and amperes of the lamps, so there is no doubt that the changes in resistance are due to temperature, and to nothing else.

I then obtained untreated base filaments from as many kinds of amorphous carbon as I could obtain, and plotted their resistance curves.

I tried filaments made of bamboo, silk, cotton, cellulose (made by the ordinary squirt process), tamadine, and paper. All of these base carbons gave the same curve, and all of them continued to fall in resistance as long as I was able safely to increase the temperature.

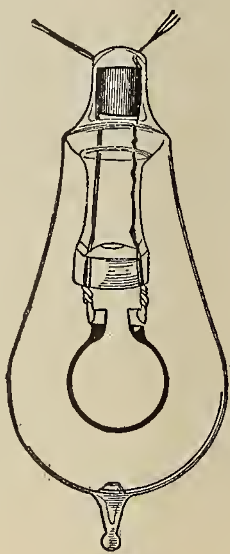


Fig. 3.

These carbons were quite different in their physical characteristics. The silk filaments were the most porous, and had the roughest and the best heat radiating surface, while the tamadine filaments were very dense and had a very highly lustrous surface.

I was entirely unable for a long time, after making these curves, to come to a satisfactory theory regarding them. The reverse curve is not caused by changes in the characters of the surfaces of the carbons, due to emissivity, because no corresponding changes in emissivity occur.

I made observations upon untreated and heavily treated filaments, to see if they acted differently in regard to their expansion with heat, thinking that possibly the changes in the resistance curve may have been caused by a change in the expansion curve with temperature. These observations were not very refined, being simply observations made by means of a telescope, but they showed clearly that all of the carbons expanded with heat, and apparently there was no difference in this respect.

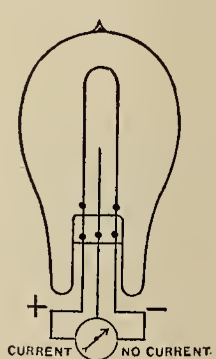


Fig. 4.

It has been the custom for some time to speak of the carbon which is obtained by the treating process as graphite carbon, and knowing that Mr. Edison had in 1881, made some filaments of graphite, by pressing the pure graphite, under very great pressure into the form of loops, I was very anxious to obtain a lamp containing one of these filaments, to see whether it would have the same resistance curve as the other forms of untreated carbon. I

have very recently obtained one of these lamps from Prof. Barker, of the University of Pennsylvania, and upon plotting its resistance curve I was very much pleased to find that it had the same characteristics as the heavily treated filament. It reached its minimum resistance at a dull red heat, and from this point, as the temperature was increased, the resistance increased also. This curve is marked G upon the sheet on which the other curves are plotted.

It will be observed that the resistance curve of this filament does not fall as much as the other curves, and rises much more. This may be due to the different natures of the two kinds of graphite, or to structural differences. The top of the loop of the graphite filament got much hotter than the rest of it ; this would cause this part to start rising before the rest had ceased falling in resistance, and this may account to some extent for the less total fall in resistance of this filament. The resistance of this filament, after the measurements had been made, was just the same as before they were made This indicates quite clearly that our calling the treated carbon "graphitic" is correct, and that the change in the resistance curve of treated filaments is due to the graphitic nature of the layer of carbon which is put on during the treating process.

The graphite filament lamp referred to is shown in Fig. 3.

The second part of this paper, which relates to the conductivity of the vacuous space surrounding incandescent filaments, may be considered as a discussion of the paper upon the "Edison Effect" in incandescent lamps, which was read before the institute by Professor Houston, in October, 1884, and which was the first paper read before this society.

"Edison Effect" is the name given to the effect produced by those currents, first observed by Mr. Edison, which pass from one leg of an incandescent filament across the vacuous space to the other leg, and which can be observed by connecting a galvanometer between the positive lamp terminal and a wire sealed into the bulb and projecting into the vacuous space.

Figure 4, which is taken from Professor Houston's paper, serves to illustrate Mr. Edison's original experiment. The galvanometer indicates a current flowing from the positive lamp terminal through the galvanometer and third lamp wire, and through the vacuous space to the negative leg of the incandescent filament. If the external connection of the galvanometer be changed from the positive terminal to the negative terminal, no current will flow through the galvanometer. This effect can be observed in the most highly exhausted lamps. A lamp so highly exhausted that it shows no glow when tested with an induction coil, giving a spark $\frac{3}{4}$' long, will allow a current sufficiently large to show plainly on a not very sensitive galvanometer, to pass through its vacuous space. This current increases as the temperature of the filament is increased, but in a well exhausted lamp is never greater than a very few milliamperes, when the lamp is burned at about $2\frac{1}{2}$ watts per candle.

In 1884 Mr. Preece secured from Mr. Edison some lamps having wires sealed into the bulbs, and read a paper before the Royal Society describing some experiments made upon them, illustrating the "Edison Effect."

(To be Continued).

Printing Room showing Electrically Driven Presses and Absence of Belting and Shafting.

THE ELECTRICALLY DRIVEN PRINTING ESTABLISHMENT.

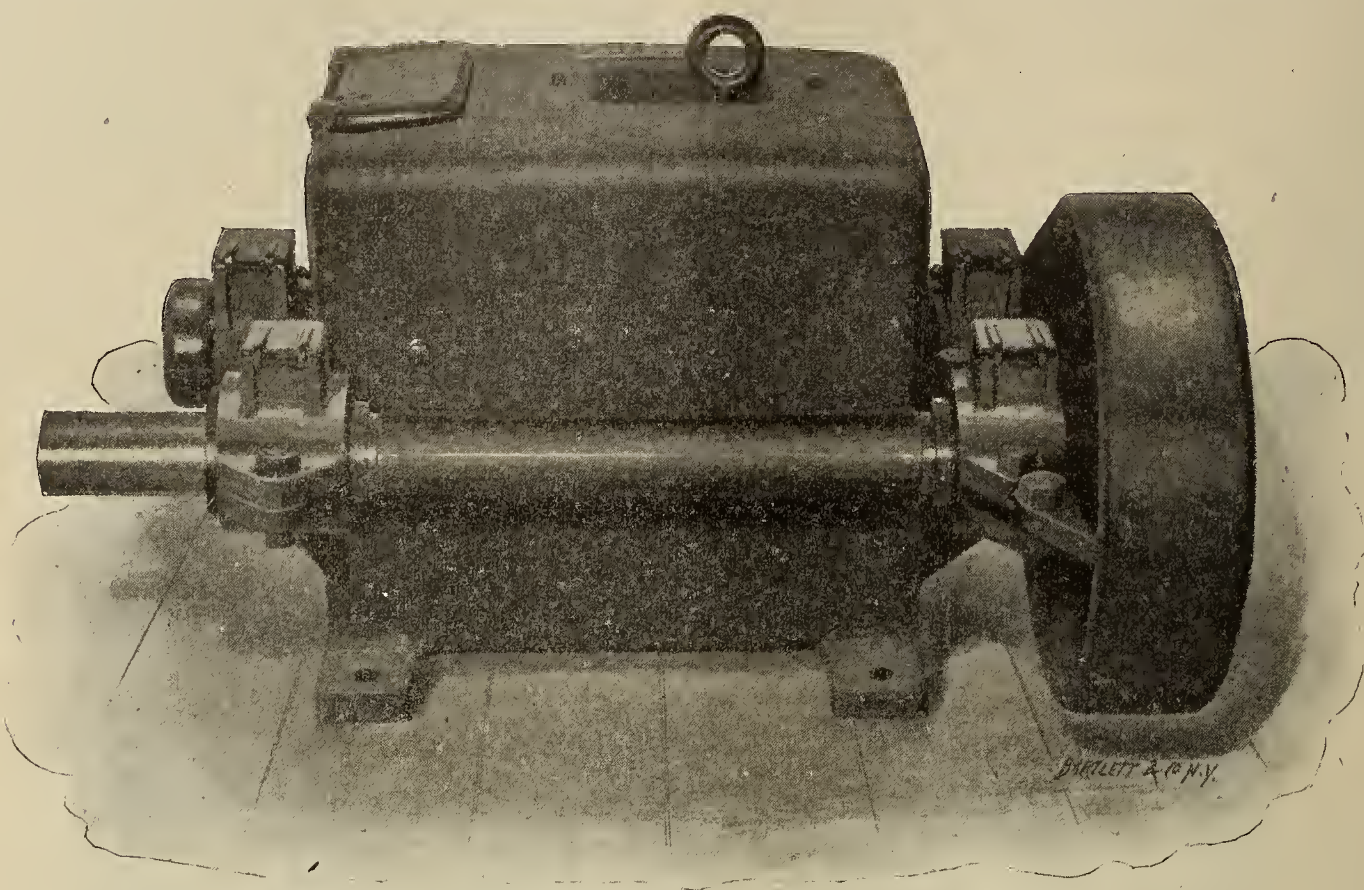
The writer has had sufficient experience with printers to realize how very conservative they are in the adoption of improvements, particularly when they affect the shop machinery either in its general operation or method of driving the same.

Many cases could be cited in which printers clung to their gas engines with a pertinacity that might be mistaken for an idolizing affection. This is frequently due to the fact that they understand its working parts and can always estimate the general size of the gas bill each month.

Their fear of a change does not reside so much in the dislike that becomes biased prejudice as in the terror of introducing into their daily affairs a factor that may disturb their equanimity and when inoperative be beyond their powers of investigation. So old an art must needs have clinging to it much of the mustiness of olden times. A case came within the writer's experience not very long ago in which a 4-horse-power motor was installed to be used as a relay to a 7-horse-power gas engine. It was only after considerable persuasion that this motor was installed. In the course of time the printer moved to larger quarters, and his first move was to buy a 15-horse-power motor for driving the presses; the gas engine to hold the honorable position of relay in case of emerg-

ency. In the accompanying illustrations a Crocker & Wheeler Electric Company equipment is shown.

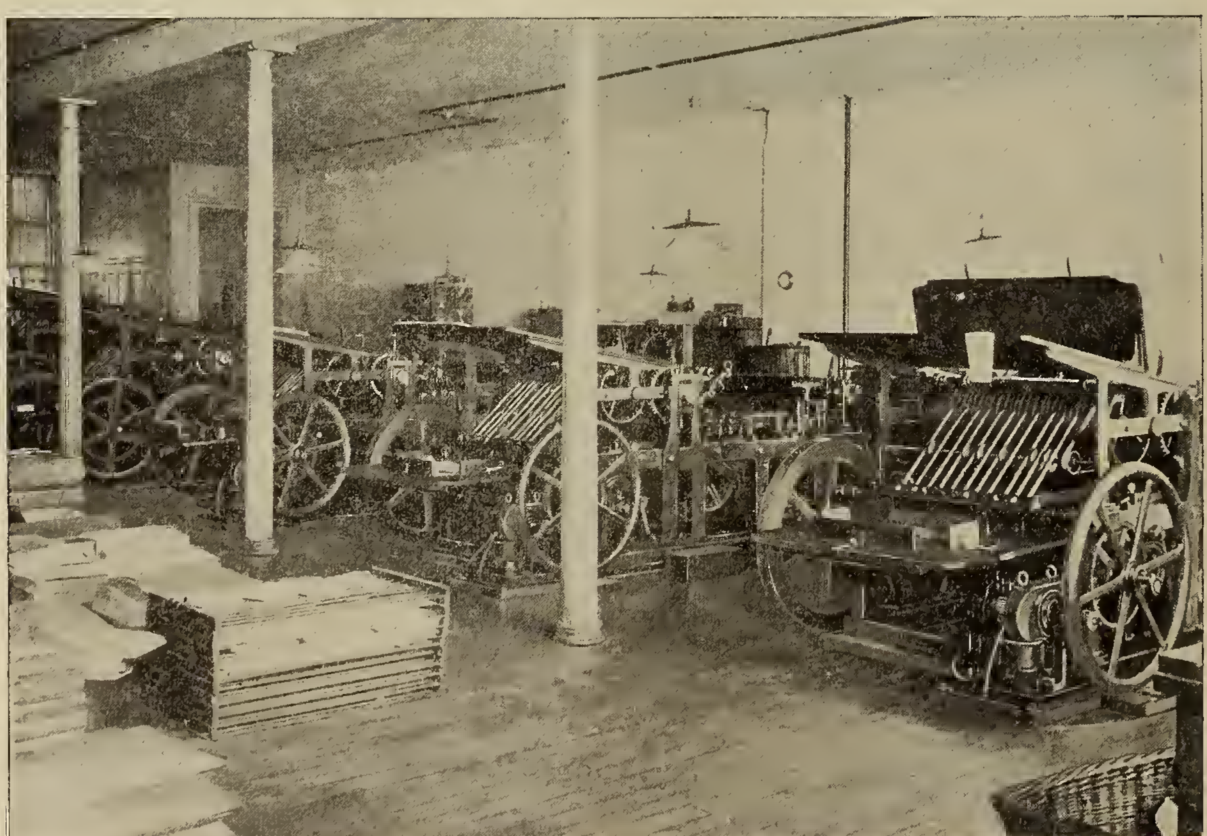
None can help appreciating the great advantage of a shop in which power is only used when required. The absence of belts removes an element of danger and wasted power that is of considerable importance in their economical and safe operation.



Size 22 Mill Motor, Single Reduction. Ratio of Gears, 1 : 3.94. Weight, 1,675 lbs.

The additional illustration of a mill motor of Crocker & Wheeler make is noticeable for its compactness and finished workmanship.

For a great many years particular applications of motors were unknown; yet today there is hardly a large shop that aims at progressiveness which is not relying upon some device operated solely by a motor, intended for that special work and solely fitted for it.



Electrically Driven Presses; Absence of Belting and Shafting.

Mr. Perry distributed the following circulars at Coney Island quite recently: A booster will be used from Pearl street, Brooklyn, to sustain the load.

ELECTRIC LIGHTS.

The Edison Electric Illuminating Company, of Brooklyn, will begin the furnishing of current at Coney Island on Decoration Day, May 30, 1897.

Incandescent lights, arc lights, power service, all on meter basis.

For further information apply at Coney Island branch office, West 5th street, near Neptune avenue, or general office, 360 Pearl street, Brooklyn.

To heat a kettle of water by electricity a new device consists of a water-tight insulated metal ring having a cross-brace and an upright handle through which the wire conducting the current passes. All that is necessary to operate it is to set it in the kettle of water and turn on the current.—Philadelphia Record.

The Electrical Age.

ESTABLISHED 1883.

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NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, MARCH 6, 1897.

CONTENTS.

THE ACCESSION OF WEALTH THROUGH INDUSTRY.

As a great industrial race, perhaps no better representative can be chosen among the nations of the earth than the American. Rated impartially, it will be seen that for a given time its growth has been marvellously rapid and the advantage it has taken of natural products and facilities places it among the foremost of busy workers on this globe.

The accession of wealth through industry has been an important factor in elevating the national standard and gaining for Americans a universal reputation for trustworthiness.

In fact, the standing of a nation can well be measured by the industrial kings it possesses.

Upon the broad foundation of labor rests the greatest of republics; its wealth is the people's and in the people resides its wealth.

Progress has marked out for itself great canals in the markets of this country—notably prominent in relation to electrical manufactures.

Each newly developed industry assists in bringing about a general prosperity—a gradual uplifting of the lower plane of labor to a position of greater worth.

The greater the number of large industrial developments the more noted is the improvement in the beating of the national pulse.

Encouragement may enter into many hearts by a perusal of the following note, whose authenticity may be looked for by reference to the Inventive Age:

"In 1870 the property of the United States was valued by the census authorities at $30,000,000,000 in currency, or $24,000,000,000 in gold. In 1890 that property had so increased in value that it was worth $65,000,000,000 in gold. In twenty years the people of this land added to their tangible possessions property to the value of $41,000,000,000 in gold. But more important are the facts showing the distribution of these vast accumulations of recently-acquired riches. The census of 1850 estimated the number of real estate owners in the United States in that year as 1,500,000. Therefore, at that time, according to the census, 6.47 per cent. of the population and 35.95 per cent. of the families in the country were possessed of real estate, either free or encumbered with debt. The census of 1890 reports 6,066,417 families living in houses or upon farms owned by themselves. Of this number 4,369,527 owned their farms and homes, free from all mortgage encumbrance. In addition, there were many other owners of real estate, besides these owners of houses and farms used as homes. The owners of homes free from debt made up 6.98 per cent. of our population and 34.93 per cent. of our families in 1890. Taking the individual as the unit, the improvement is equal to 50 per cent. The facts cited show that, whatever may be our present transient indications of prosperity, we have in them from 33 to 50 per cent. more ground for expecting such prosperity than had our fathers in 1850."

This week, Americans will usher to the presidential chair with love, honor and reverence their new executive. Many hopes have been placed in him. Upon his tact and prudence depends much of our happiness and prosperity.

Great questions must be settled without delay. There is in President McKinley a spirit that lives for the people and in whom we predict resides powers that are full of future benefit.

OCEAN TELEPHONY.

The problem that has interested many an able mind is that of ocean telephony. The cable stretching across the great Atlantic abyss is a huge condenser, whose capacity is estimated at over 1,100 microfarads. The conditions required for the elimination of this capacity is a distributed self-induction. By having a self-induction and capacity adjusted to the conditions imposed by telephonic work, a possibility exists of transmitting electrical oscillations of a limited frequency.

If the Atlantic cable were a huge spiral of an appropriate number of turns per mile, in all probability its capacity would disappear.

Otherwise, the only hope we have left is in the discovery of a dielectric whose specific inductive capacity is exceedingly low.

Auburn, Feb. 28, 1897.

To the Editor.

Dear Sir:—The American Institute of Electrical Engineers published a paper in the past written by two engineers who had been experimenting with high-speed railway motors.

I do not know in what part of the Transactions to find them and have not the means of getting copies. I would also be gratified to know what their conclusions were.

Yours truly.
A. S. Silver.

(A.)—The paper entitled "Report of High-Speed Electric Railway" was read by O. T. Crosby, February 24, 1891.

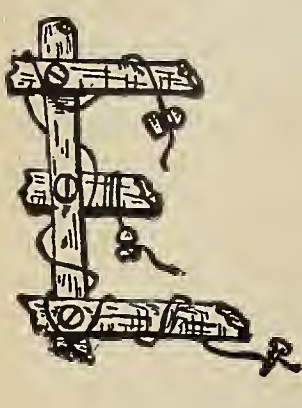
The conclusions reached were to the effect that the "chances are in favor of this being accomplished."

Likewise, "It would seem that a speed of 120 miles an hour, or even more, with the electric cars, would not be outside the limits of safety."

THE TESTING OF LINES.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

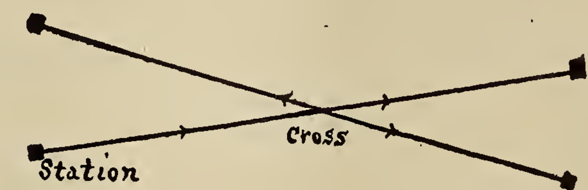
BY NEWTON HARRISON, E. E.



NTIRE freedom from crosses and grounds on a line is secured by constant attention, regular testing and inspection. When a line is crossed with another line the signals sent over the first do not reach their destination but affect the sounder of some other station not supposed to receive the impulse.

Crosses.—Not only may this occur but the current may return to a ground circuit, if the cross brings it into contact with such, and also become lost, as in the first case. Crosses therefore may be looked upon as causing a straying of signals, or possibly their complete disappearance. The location of a cross is made by testing the line. Should its resistance be greater or less than is usual the trouble is at once indicated, but not its nature. A ground is likely to assume the same appearance as a cross when superficially tested. A cross can therefore be discovered by the fact that the resistance of the line has changed, and also by a lack of signals at the other end. Each station has its own peculiar signal to receive when communications are to begin with any other. A cross may thus create a disturbance in either one or more lines, and by a resistance test be located. When a difficulty of this kind occurs with an electric light line a set of fuses will blow and save it. A source of trouble that is very irritating to a telegrapher, and which fortunately occurs very infrequently, is the swinging of telegraph or telephone lines. They may touch for a long while when the wind blows, or only occasionally, causing a temporary cross or ground which when looked for disappears to return at odd moments. *Swinging crosses or grounds* are best removed when the line is at rest; the early morning or evening or whatever time allows for such investigation. The loss of conductivity in a line may be traced to several causes. One of the most common is poor connections, etc. If a line is free from all difficulties, its length should represent a definite resistance when tested. The tests made for conductivity are simple; they differ from those made for insulation resistance in degree merely, in all other respects being identical.

Breaks.—A break in a line necessarily destroys all means of communication with the other end, unless the broken portion lands in a brook or on another line. If the ground connects the broken end, a test made of the resistance of the line will disclose the fact that it is incomplete. If the resistance of contact is high, the familiar features of partial ground manifest themselves without, however, any signals being received at the other end at all.



Grounds.—When the line falls into contact with the earth it is like to do so in two ways; they are spoken of under the following heads:

Dead grounds,
Partial "

Dead grounds.—A dead ground is so called when the contact between the earth and the line is electrically good. A pole may be decayed inside, saturated with water and practically ground the line as well as if a plate were used. The pouring rain may stream down the pole, or a collection of them, and cause a dead ground. In this case the signals cannot possibly reach the other end, but return home through the faults. A wire hanging from the line to the earth and touching a grating or a cornice, or even piping of some description, produces this defect. Its location is found by measuring the resistance of the line. If, for instance, the normal line resistance = 100 ohms and the test shows only 80 ohms, the ground exists at a point $\frac{8}{10}$ of the distance from the station; this, remember, is based upon the supposition that the line is dead grounded at that point. In making the test, one end of the line is connected to the Wheatstone bridge and the other end leading from the ground plate also to the Wheatstone bridge. The circuit is now complete through the line, dead ground, earth and Wheatstone bridge. The resistance of that portion of the line in contact with the earth and between the ground and the station is thus found. Its resistance in ohms represents an equivalent in feet. It may be 10 ohms per mile or 100 ohms per mile; in any case, this data determines its position.

Partial grounds.—This common fault develops due to many cases, such as contact of the wire with a tree, or the leakage due to very poor insulation at any given point of the line.

Line Grounded by Wire

In testing a line for a partial ground the position of the leak is determined by a double test. Calling one telegraph station A and the other B, the line between would be called A B. The ground G is of a resistance that in each test is included with the resistance of that part of the line from which the test is made. In measuring the resistance of the line from A, the circuit is opened at B. Therefore, the resistance measured is equal to that through A and G back to the station. This being done the line is opened at A and tested from B; the resistance is measured through the B portion of the line and C.

Test (1) resistance = A + G.
" (2) " = B + G.

The rule employed for finding the position of the ground from A and from B is as follows:

$$\text{Resistance of A portion of line} = \frac{\text{Resistance of test (1)} + \text{resistance of (A+B)} - \text{resistance of test (2)}}{2}$$

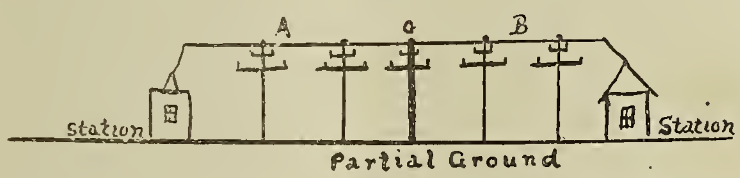
or conversely the resistance of B portion of line =

$$\frac{\text{Resistance of test (2)} + \text{resistance of } (A+B) - \text{resistance of test (1)}}{2}$$

The resistance of the entire line is known either by its length in miles of a given size of wire, or by a resistance test.

Taking a case in practice as follows: A line is grounded and a test made from each end through the ground with this result:

Test (1) from A through ground = 1075 ohms.
" (2) " B " " = 1025 "



To find the number of ohms the ground occurs away from either A or B, the rules are applied and, when the ohms are known, the distance is understood.

If the line had 10 ohms to the mile its location would be (if the line has 100 ohms resistance)—

$$\text{From A} = \frac{1075 + 100 - 1025}{2} = 75 \text{ ohms.}$$

$$\text{From B} = \frac{1025 + 100 - 1075}{2} = 25 \text{ ohms.}$$

At 10 ohms to the mile the ground is

7.5 miles from A
2.5 " " B.

This test applies equally well to telephone, telegraph and electric light lines.

The cross talk on telephone lines is due to the electromagnetic or electrostatic induction occurring.

The electrostatic seems to be the most effective in producing the trouble so familiar to all. The remedy for this is applied by twisting the wire; the inductive action being neutralized throughout by this means.

Covering the wire with an iron inductive coating of the best possible description will tend to reduce this difficulty to a great extent. At times the most novel practices are employed, such as surrounding the wire with crimped paper, etc. This is done to embody as much air as possible in the covering; air having a less inductive capacity than other materials, and therefore prevents induction to a considerable extent.

The usual tests made of a line bear reference to its

Conductivity,
Insulation,
Capacity.

A sensitive galvanometer and a bridge will enable these tests to be successfully made.

Conductivity of one wire.—This is found by grounding one end and allowing the other to go to the arm of the bridge, measuring the unknown resistance, and then to the earth. The earth resistance being zero, the line may be measured.

Conductivity of a line by means of another.—If two lines lie side by side they may be measured without grounding, provided they be of equal gauge. Their extreme ends are twisted together and the other two ends connected to the bridge arm. The total resistance measured divided by two will equal the resistance of either.

To measure the conductivity of three lines.—If three lines of the same or unequal resistance are side by side, and the resistance of each respectively is to be found, three tests are essential by this method.

Calling the three lines A, B and C, the three tests take in the combined resistances of A and B, of B and C, and of A and C. This is obtained by joining their ends all together, leaving the three other ends free for the tests.

tests (1) resistance of A + B
" (2) " " B + C
" (3) " " A + C

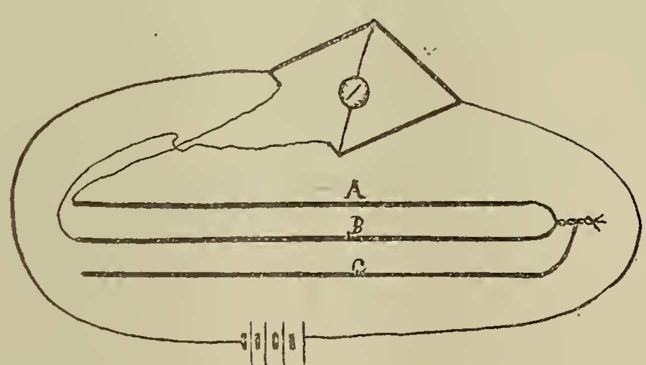
The rule to be applied is then as follows:

$$\text{Resistance of A} = \frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2} - \text{test (2)}$$

$$\text{Resistance of B} = \frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2} - \text{test (3)}$$

$$\text{Resistance of C} = \frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2} - \text{test (1)}$$

The last is not necessary, as C may be found by subtracting A and B from



$$\frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2}$$

To illustrate this case

test (1) = 110 = A + B
" (2) = 130 = B + C
" (3) = 100 = A + C

$$\frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2} = 170 \text{ ohms.}$$

Then A = 170 — 130 = 40
B = 170 — 100 = 70
C = 170 — 110 = 60

Thus the resistance of lines may be determined irrespective of their size by this method.

The drop of potential in a line is very great, being more than the average in very dry weather and less in wet weather. If a line has a change in insulators the

percentage of current received is shown by the following table, prepared by Moses G. Farmer.

"Distances in miles a percentage of the current will reach through a line of 18 ohms to the mile and the following insulators:"

Percentage of Current Received.	Insulation Resistance in Megohms, 30 Insulators Per Mile.							
	Megohms 1	4	9	16	36	100	1000	1600
10%	Miles 125	258	386	516	774	1290	4094	5160
25	89	178	267	356	534	890	2837	3560
50	58	116	174	232	348	580	1850	2820
75	36	73	109	146	219	365	1161	1460
90	22	45	67	90	135	235	766	900

The *Electric Telegraph*.

THE MODERN POWER HOUSE.

BY RICHARD M'CULLOCH.

(Continued from Page 133.)

The first cost of the direct-coupled generator is about 35 per cent. more than the belted generator in the 500-K. W. size, which is the largest standard size in which the belted generator is made; but when the expense of the belt, belt-tightening device and the floor space is taken into account the direct-connected generator will be found the cheaper. Besides obviating the necessity of the costly and cumbersome belt, the direct-connected generator offers the following advantages: In large sizes and in connection with large engines it has a much higher efficiency than the belted unit; it requires a small floor space; it aids supervision by bringing the working parts of the engine and generator close together; it reduces danger; it is almost noiseless in operation and it may be installed in a larger unit than the belt-driven generator, which is limited in size by the width of the belt and pulley which may be employed. The main objection which was urged against the direct-connected generator was the fact that the shocks resulting from over-loads were thrown directly on the engine and that there was none of the cushioning effect that a belt-connection might supply. While this is undoubtedly true, the best argument which may be submitted against it is that none of the installations of direct-driven generators can trace any trouble to this source. The large, slow-speed, multipolar, direct-driven generator has become, perhaps, the most prominent feature of the modern power house, and while there may be special services which would necessitate a belted arrangement, it is difficult to imagine a power house thoroughly up-to-date without direct-driven generators.

By varying the number of poles and the number of armature conductors in the construction of a dynamo, the machine may be designed to run at almost any reasonable speed; the slower the speed, however, the greater being the cost of the dynamo. In the matter of speed it is necessary for the dynamo maker and the engine builder to effect some sort of a compromise, because it is not good practice to run such large engines at too high a speed. The speeds which are most common are 75 revolutions per minute for the 1,500-K. W. dynamo; 80 to 120 revolutions per minute for the 800-K. W. dynamo, and speeds running from this to 150 revolutions per minute for the smaller sizes. These speeds are what would have been considered, four years ago, quite out of the range of the Corliss valve gear, but the makers of this type of engine have risen to the occasion and now there are numbers of large Corliss engines driving generators at speeds up to 100 revolutions per minute, and some have even higher speeds than this. Several other types of engines have been adapted to this work and are running quite successfully. Outside of the question of valve gear, most engines made for this work possess the same characteristics—the heavy bed-plate, the solidly constructed fly-wheel, now being made of steel-plate, the wide cross-head, the large connecting rod and the mammoth main bearings.

The choice between horizontal and upright engines is chiefly one of space. The horizontal engine is the cheaper, the simpler, the easier to inspect and the easier to repair. Outside of the advantage of requiring less space, the upright engine has the advantage of less wear on the cylinder and a more direct strain upon the foundations.

The usual practice in the most modern power houses is to install compound engines. Most of these plants are so favorably situated that condensers may be operated in connection with the engines. This is undoubtedly good practice, but in case condensers are not used the cost of fuel must be very high for the gain in compounding to pay for the extra investment. Where power houses are favorably situated on bodies of water condensing becomes a very simple problem, but in case the power house cannot be built on a body of water, as in this city, for instance, in order to use condensing engines some sort of arrangement must be designed to cool a quantity of water so that it may be used over and over again for the purpose of condensing the exhaust steam. Devices of this kind have long been in use in the city of San Francisco and in Cuba, and lately several of the large manufacturing companies have put on the market complete apparatus for the purpose of cooling water after it has condensed the exhaust steam so that it may be used again for the same purpose. Besides the gain in power by using condensing engines it is claimed that, by the use of this apparatus, actually less water is used than if the steam is exhausted directly into the atmosphere without condensing.

(To be continued.)

GREATER NEW YORK EXPOSITION OF THE HOUSE AND HOME.

In addition to the exhibition of architectural drawings, models, etc., builders' materials and interior decorations and furnishings, which will be varied and many, showing the progress and improvements made in the construction and furnishings of the home, novel attractions are being added in connection with the Amusement Hall of the Exposition, where a high-class entertainment will be given that will attract the public, and ensure the attendance of the best class of people of Greater New York.

The performances in Amusement Hall will be so arranged as not to interfere with exhibitors, who will be afforded every opportunity of benefitting by the thousands of visitors who, it is safe to assume, will attend the Exposition. There will be two performances in the afternoon, and two in the evening, with an intermission of thirty minutes between each. Admission to the Amusement Hall will be by coupon only, with no extra charge for same. This is done in order to protect the rights of exhibitors, avoiding over-crowding Exhibition Hall, and at the same time ensuring to exhibitors the patronage of visitors at all times.

Further particulars in regard to the amusement feature will be announced from time to time, as arrangements are consummated.

For the information of intending exhibitors, would say that there are a few desirable spaces left, at a reasonable figure.

Address all communications to

Daniel Browne, General Manager,
34 Park Row, New York City.

Sundridge, Ont.—Mr. Irving intends putting in an electric light plant in his woollen mill.

Electric Locomotion.—Electric locomotion is gaining ground in Europe, though by no means as rapidly as in the United States, and in all Europe at the close of 1895 there were but 111 electric roads having a total mileage of 460. Thomas Ewing Moore, United States commercial agent at Weimar, Germany, in a report, says that Germany stands foremost in Europe in electric railway construction with 252 miles, almost half of the total in Europe. France has 82 miles, Great Britain and Ireland 66, Austria coming next with 44. But twelve of the 111 lines are underground trolleys and eight accumulators.—Indianapolis News.

Dundas, Ont.—The ratepayers desire to secure the installation of an electric light plant.

THE NATIONAL CONDUIT MFG. CO.

The great interest shown by many of our readers in the methods employed for the laying of cement-lined conduit has prompted us to write this short sketch with its accompanying illustrations.

View of Trunk Line Subway Built for the New England Telephone and Telegraph Company, Springfield, Mass.

The toughest wrought iron is used for the tubes and they are lined with pure hydraulic cement.

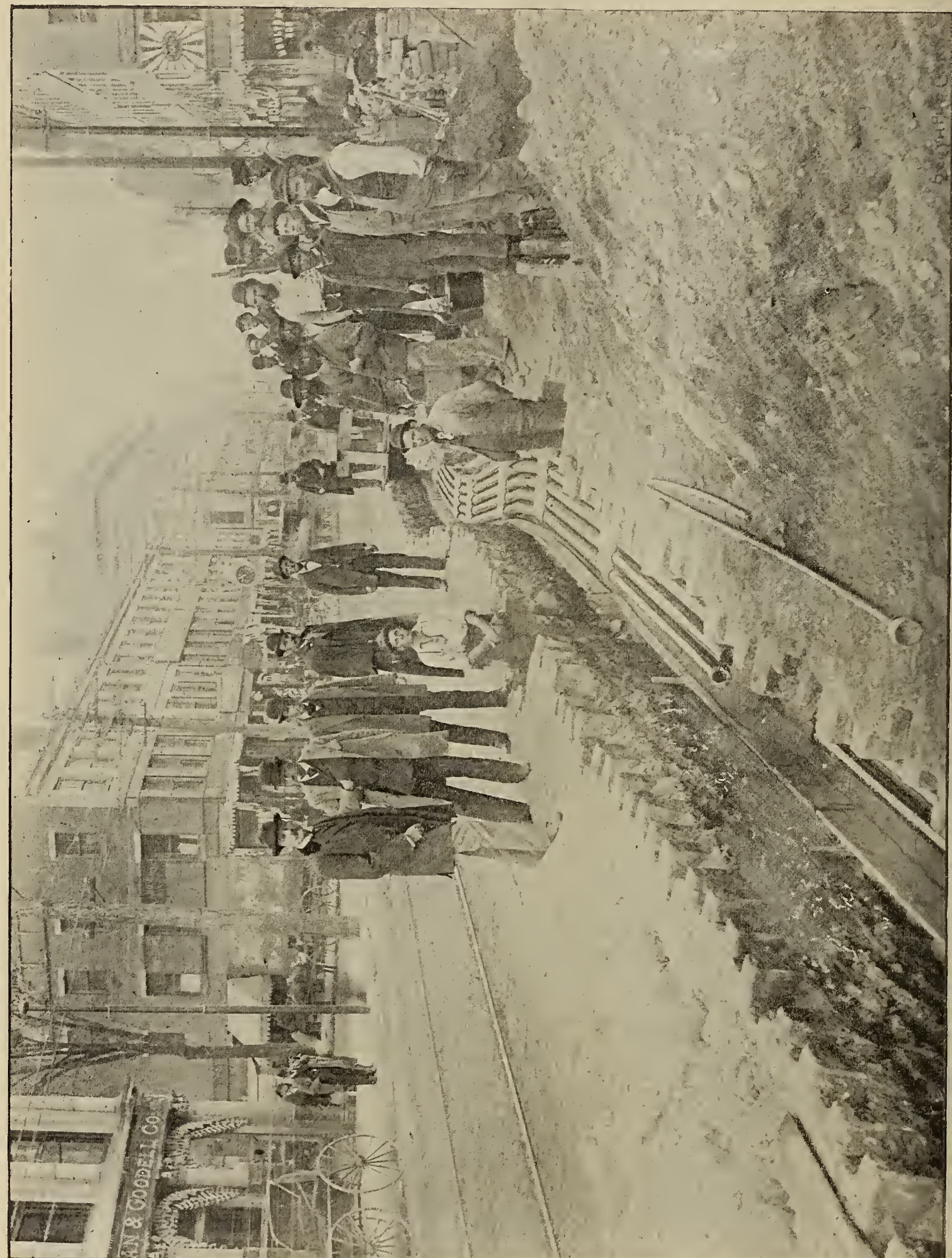
The tubes are then buried in a mass of indestructible hydraulic concrete, which hardens around them and solidifies like rock.

The illustrations show the building up of trough-like canals, with board sidings, preparatory to filling up with concrete.

The durability derived from this system of laying conduits is beyond doubt of the highest order.

The wires are protected within the tubes and the tubes within the rock-like mass surrounding them.

The National Conduit Mfg. Co., of the Times Building, New York, are one of the best-known concerns in existence. They will undertake the complete installation of any locality with their famous conduits.



View of trunk line subway showing the main leads from the Central office building of the New England Telephone and Telegraph Company, in Worcester, Mass.

The Eastern Electric Supply Company was organized in New York State March 1, 1897. President, H. B. Ellis; vice-president, Charles P. Scott; treasurer, Charles I. Hills; general manager, P. H. Ellis.

They will handle and sell everything in the electric line from a push button to a dynamo.

NEXT NATIONAL ELECTRIC LIGHT CONVENTION.

The executive committee of the National Electric Light Association have decided to hold the next (twentieth) convention at Niagara Falls, June 8, 9 and 10, 1897.

Yours respectfully,

Geo. F. Porter, Secretary.

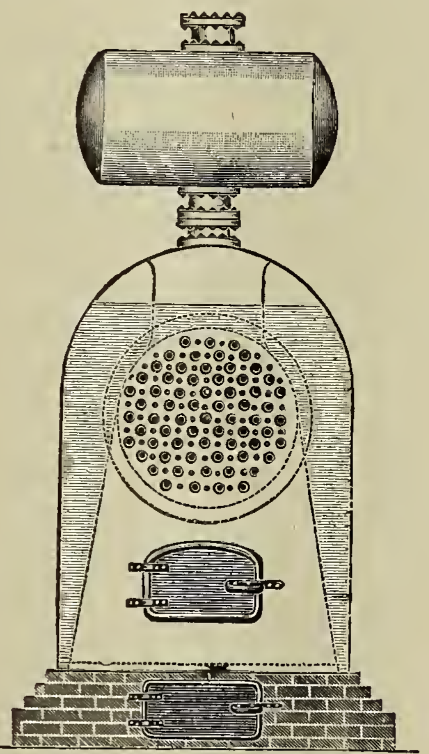
Parrsboro, Ont.—A local company is being organized here to put in a plant for electric street lighting in the spring.

Point Pleasant, W. Va.—J. Friedman & Co. desires electric light plant, to be operated by gasoline engine.

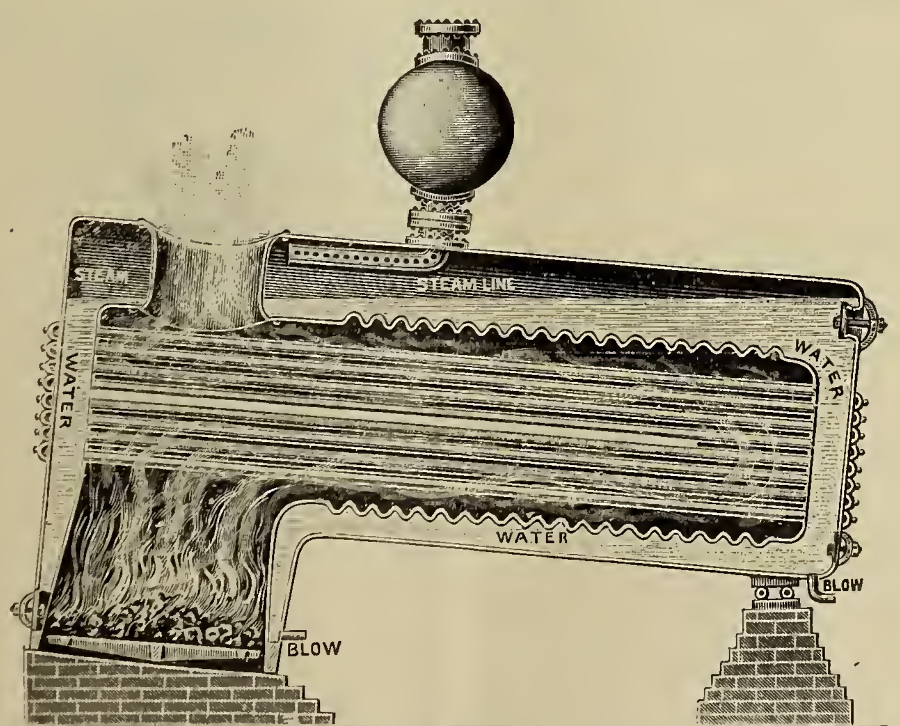
THE TONKIN WATER-TUBE BOILER.

The accompanying illustrations show the design of an internally fired water-tube boiler. The inventor is J. J. Tonkin, of Oswego, N. Y., whose intention to gain certain advantages by this construction thus manifests itself.

The inside shell contains a fire-brick division guiding the heat the entire length of the tubes before escaping. These tubes are of equal length and are readily cleaned or replaced. In this particular boiler the superior points consist in the use of water-tubes and internal firing—the immediate utilization of the heat and complete combustion. The crown sheet cannot be overheated on account of the fire-brick, and the general disposition of the gases is such that no injury is sustained in any part. Having a safety factor of five its life of usefulness with normal treatment is well assured.



End View of Tonkin Boiler.



Sectional View of Tonkin Boiler.

Neither overheating or low water will cause the injuries so common in other makes.

Mr. John Eaton, president of the Oil Well Supply Co., Pittsburgh, Pa., or Mr. Tonkin, 36 Cortlandt street, New York City, may be applied to for information concerning this boiler.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—STOPPING ELECTRIC CARS.

St. Louis, Feb. 23, 1897.

Dear Sirs:—The city of St. Louis is covered with car lines fed from the power houses. The motormen live in a state of constant trepidation, due to their fear of accidents. This, I think, is due to the fact that the cars cannot be instantly stopped, although the controller in front under ordinary circumstances is quite efficient for this purpose. How can these cars be stopped instantly without air brakes? If any electrical method has ever been contemplated or tried I would like to know.

Yours respectfully,

Philip Despar.

(A.)—Two methods of an independent nature have met with some consideration.

(a) The first is that of using a magnetic brake which

clutches the axle or a part thereof and thus effects a stoppage.

(b) The second implies the use of a dynamo whose armature may be safely short-circuited—an armature which consists of a heavy casting revolving in a magnetic field.

This last method may be used if a chance of the motor burning out is outweighed by the anticipation of an immediate danger.

That is, the car motor may be used as a brake by short circuiting it.

Space does not allow of a detailed description of the methods employed. The patent records are full of them.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of the Institute, held February 17, seventy-five members and guests were present. A paper was read by Mr. John W. Howell on "Conductivity of Incandescent Carbon Filaments, and Some of the Space Surrounding Them." The discussion was participated in by Messrs. Kennelly, Colby, Walcott, Sheldon, Wirt and Burnett.

At the meeting of the executive committee in the afternoon the following associate members were elected:

Albert W. Brown, assistant manager of telephone exchange, American Telephone and Telegraph Co., 39 Cortland street; residence, 27 West 24th street, New York.

Alva C. Dinkey, superintendent electric department Homestead Steel Works, Munhall, Pa.

Budd Frankenfield, instructor in electrical engineering, The University of Wisconsin; residence, 640 State street, Madison, Wis.

Wm. Howe Ripley, student in department of electrical engineering, Columbia University; residence, 605 Lexington avenue, New York City.

Edward B. Rosa, professor of physics, Wesleyan University, Middletown, Conn.

Christopher Van Deventer, student, Columbia University; residence, 626 Lexington avenue, New York City.

Geo. K. Woodworth, electrician, Crawford Mfg. Co., Hagerstown, Md.

The following associate members were transferred to membership:

Philip Dawson, associate and chief engineer with R. W. Blackwell, 39 Victoria street, Westminster, London, England.

Lucius T. Gibbs, manager and chief engineer, Gibbs Electric Co., Milwaukee, Wis.

Frank J. Sprague, vice-president Sprague Electric Elevator Co., 253 Broadway, New York.

Edward Andrew Leslie, vice-president and manager, Manhattan Electric Light Co., Ltd., New York City.

Yours truly,
Ralph W. Pope,
Secretary.

WILL USE ARC LAMPS HENCEFORTH.

W. C. Ballda, manager of the Utica Electrical Manufacturing and Supply Company, has secured a contract from Hugh Glenn & Co. for the placing of forty long-burning Manhattan arc lamps in their stores, 54, 55, 58 and 59 Franklin Square, they having decided to throw out the incandescent lamps and to equip the entire store with 150-hour arc lamps.

The Queens Insurance Company Building, corner of Cedar and William streets, New York, has been equipped by him with 2,000 lamps, the Walker Company putting in the dynamos. Mr. Chapin has fine show rooms, and his offices and reception rooms are always open to friends. His early experience has made him one of the oldest and ablest men in the business.

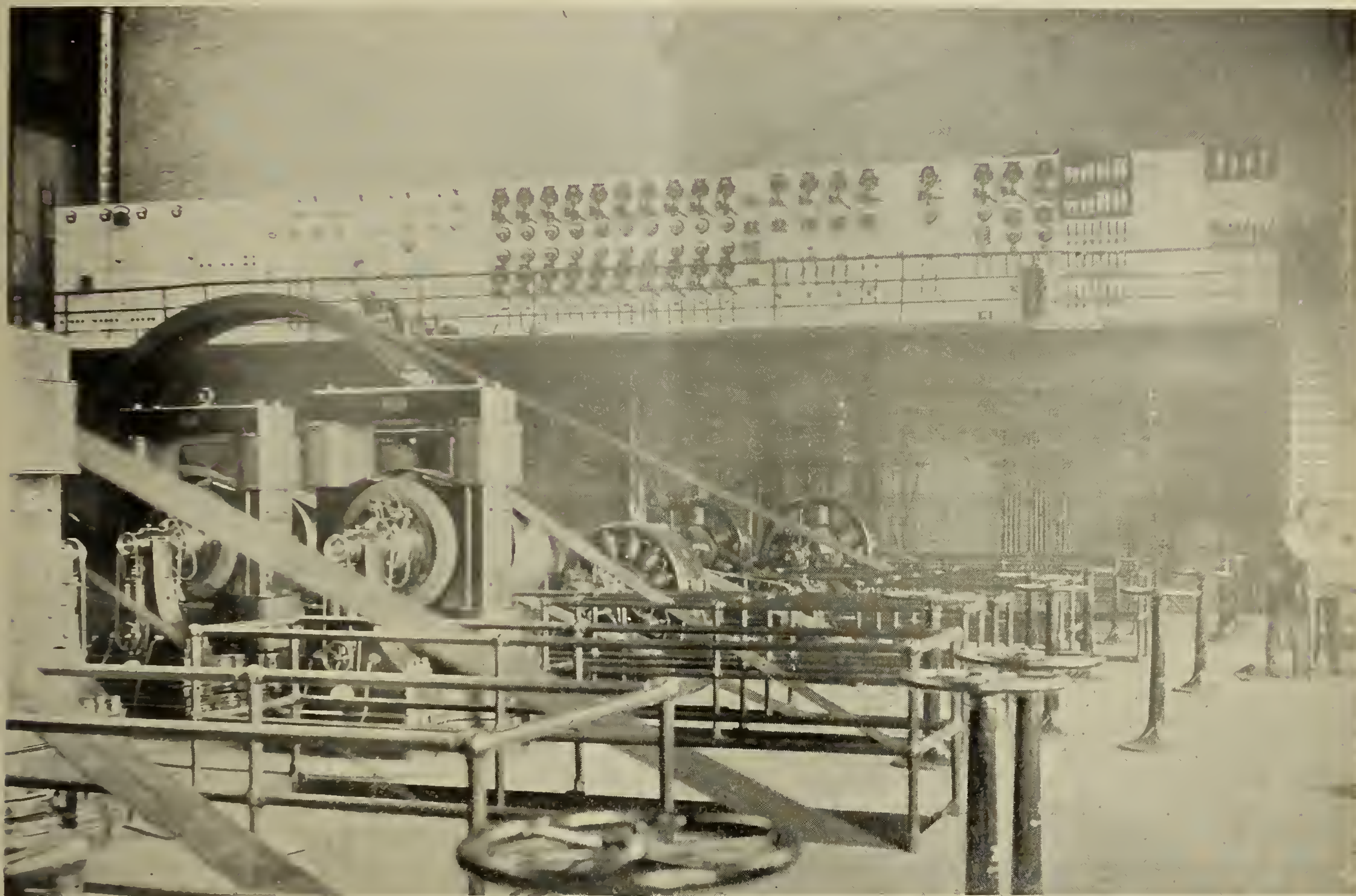
ELECTRIC STOCK QUOTATIONS.

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	35	38
Eddy Electric Mfg. Company,	—	19
Edison Illg. Co. (St. Louis),	1	2
*Edison Elec. Illg. Co., New York,	104¾	105¼
Edison Elec. Illg. Co., Brooklyn,	98	99
Edison Ore Milling Co.,	7	10
Edison Elec. Storage Company,	28	29
East End Electric Light	—	10
Fort Wayne Electric Company,	⅞	1
Ft. Wayne Elec. Co. T. Sec. Series A,	3	3½
General Electric Company,	34½	35
General Electric Company pf.,	74	76
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	81½	82
Rhode Island Elec. Protec. Co.,	110	122
Toronto (Canada) Elec. Light Co.,	125	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4
Thomson-Houston Welding Co.,	5	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse El. & Mfg. Co., pf.,	50	51
Westinghouse El. & Mfg. Co., assd.,	24¼	25½

*Ex dividend.

The Electrical Age.

VOL. XIX., No. 11. NEW YORK, MARCH 13, 1897. WHOLE No. 513



Toledo Traction Co.'s Plant, Fort Wayne 150-Arc Lamp Dynamos in the Foreground.

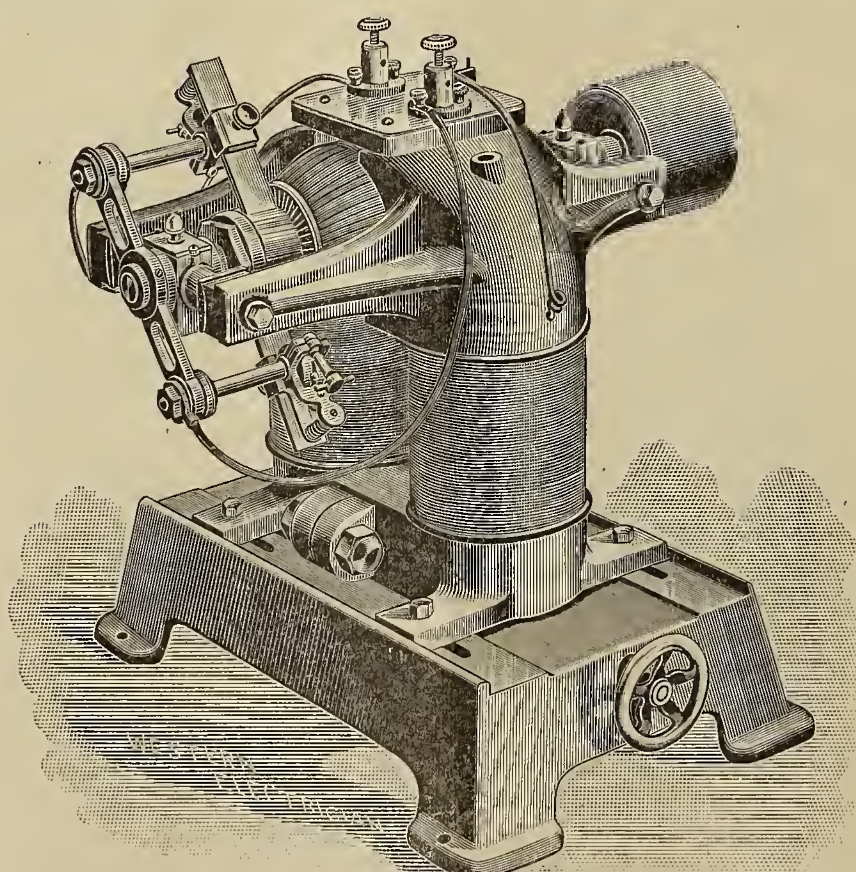
TOLEDO TRACTION COMPANY, TOLEDO, O.

The city of Toledo is evincing a desire for progress that has of late brought it prominently into notice. There is within the city limits an amount of concentrated ambition that could scarcely be equalled by that of any other American centre. Its inhabitants number about 120,000, with every prospect of rapid increase in the future. The electric lighting, power and railway work has advanced with the utmost rapidity. The Toledo Traction Company, to which this article refers, was organized representing the consolidated interests of the Toledo Consolidated Street Railway Company, the Central Street Railway Company, the Metropolitan Street Railway Company of Toledo, the Ironville Street Railway Company, the Toledo Electric Street Railway Company and the Toledo Electric Railway Company. The capitalization of these large concerns represents $2,000,000 in preferred stock, $4,000,000 in common stock, and $5,000,000 in bonds. The president of the company is Mr. N. B. Ream, a well-known Chicago financier and capitalist. This concern controls and governs more than 120 miles of track, which forms a network over the entire city and its suburbs. About 119 closed and 100 open cars are in use, 29 trailers, 5 snow-plows, 284 motors and 147 trucks in the best of condition. The following technical facts may be of considerable interest to our readers. All the T-rail tracks have been newly laid and substantially rebuilt within the last five years. The ties are of the best quality oak and figure about 2,600 to the mile. The streets in Toledo through which these tracks run represent considerable care and expense on the part of the municipal government, being paved with stone, brick, wood and asphalt. The new power-house just finished is a fire-proof building situated on the Maumee River, which passes through the centre of the city. Its dimensions are 212 feet by 115 feet with steel frame, brick walls, slate and tile roof. A huge steel smoke-stack 213 feet high is a most noticeable feature of this power-house. This great smoke-stack is 13 feet inside diameter and is lined with fire-brick. The power plant is composed of the following generators: Four new 1,000 K. W. Edison generators for three-wire system; 7 Fort Wayne generators for arc lighting of 150 lamps capacity each; four 500-K. W. General Electric, direct-connected generators, for railway and power service; two Porter-Allen tandem compound engines; four 1,200 H. P. American Wheelock-Green engines, 90 revolutions, cross-compound valves and gears, built by The A. Wheelock Engineering Company; remainder by William Camp & Sons, of Philadelphia. The city of Toledo has a contract for street lighting with this company lasting until 1900 and requiring them to furnish 800 city arc lights. The incandescent lights number about 35,000. All are operated from the new central power station, Madison and Water streets. The firm of Sargeant & Lundy, of Chicago, Ill., were the consulting engineers for the electrical and steam engineering. The new central station of which we speak is doing the best of service, being constantly in use, the entire twenty-four hours being pretty heavily loaded and supplying its power with the greatest economy. The power-house is equipped

with four 500-H. P. Hine boilers, four 300 H. P. Stirling boilers, two Hawley down-draft furnaces, six MacKenzie furnaces and the Green fuel economizers. The General Electric Company supplied the switchboard, which is equipped with a number of Weston instruments. The board itself is of Italian marble and is remarkably handsome in appearance. The business part of the city is full of subway ramifications. Several hundred thousand feet of the well-known cement-lined pipe, furnished and laid by the National Conduit Manufacturing Company, of New York, are in use. The railway, arc lighting and the three-wire systems of incandescent lighting contains over 100,000 feet of cable furnished and laid by the National Underground Cable Company. The cables vary in size as follows, one million C.M., 500,000 C.M., 200,000 triplex, No. 14 triplex and No. 6 single. Mr. Winfield S. Jewell is the general manager of the plant. Mr. E. S. Reid supervised the installation of the national conduit and cable, even to connecting up cables and wires to generators. Mr. J. E. Bechtel, a man of remarkable ability and experience, is the electrical engineer of this plant. Some additional facts are supplied worthy of the greatest notice. The American Wheelock engines previously spoken of can be used on railway or line-shaft, or both. The average total output now lies between 35,000,000 watt-hours per day. The boiler feed-pumps are in connection with air-pumps. The electric feed-pumps are in reserve. The power-house is equipped with coal and ash elevators, likewise a twenty-ton travelling crane. A peculiar feature of the plant lies in the fact that a rope drive is used from the engine to the line-shaft, but belts are used from the shaft to the small generators. As a final fact it may be stated that the electric light machinery is connected by friction clutches with the line-shaft and power is transmitted from each engine to this shaft.

Installing National Underground Cables in National Underground Conduits.

Port Arthur, Ont.—The street railway company will likely put in a plant at the power house for the lighting of the town to consist of a dynamo capable of running 1,300 sixteen-candle-power lights.

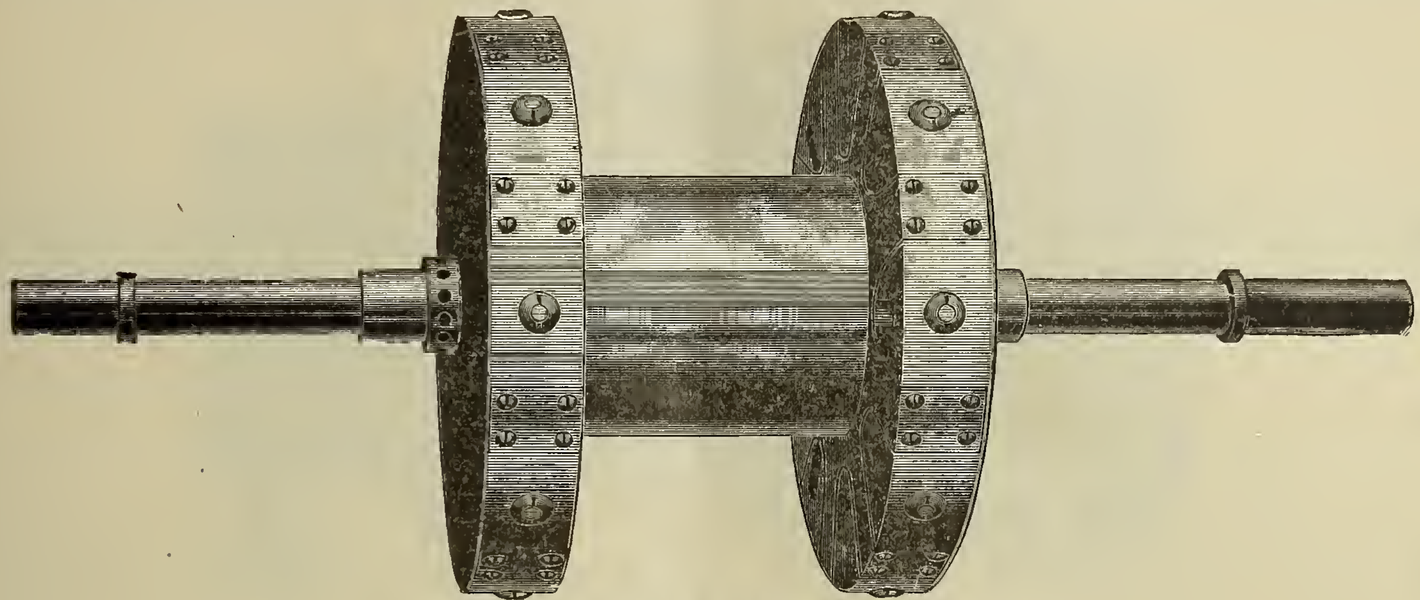


Exciter, Royal Electric Co.

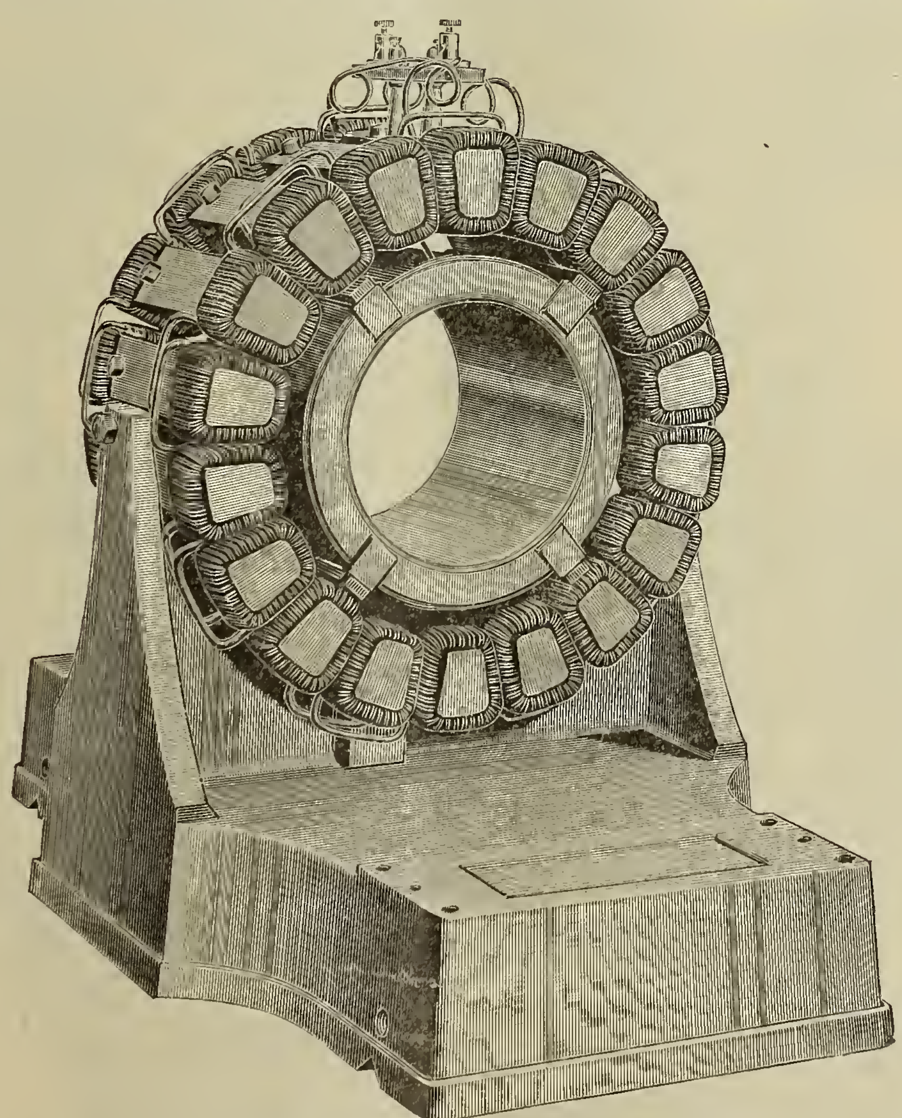
The Ajax Lamp Company, of New York City, has been incorporated, with a capital stock of $100,000. The directors are Bernard F. Pomeroy, Ernest Woltmann, Luther E. Shinn, David H. Gildersleeve, Henry A. Kirkham and Jacobi Loewenthal, New York, and Charles S. Van Nuis, New Brunswick, N. J.

MODERN ELECTRIC LIGHT MACHINERY.

In turning back the pages of history we cannot help feeling interested in the changes that have occurred since the most remote ages. The successive steps of progress shine forth from its pages with distinct prominence. Similarly the development of the art of electric lighting brings to our mind and to the recollections of many, certain interesting advances. From the discovery of Faraday and Oersted, brilliant in their possibilities, to the latter-day improvements and inventions, there are to be seen the same familiar characteristics, the remarkable changes that herald an unwonted commercial activity. It seems that machinery requires for its success an element of simplicity which, if lacking, is apt to leave it behind in the race of competition. We find in investigating the various classes of apparatus, second to this feature is found that of durability and economy. The Royal Electric Company, of Peoria. Ill., have fully realized in the course of their commercial existence that there is and always shall be a demand on the part of consumers for simple, durable and economical machinery. They have, therefore, built for practical use both alternating and direct-current apparatus. The machines manufactured by them are of the best workmanship, the finest hammered crucible steel shafts of sufficient diameter are used, bearings which in their latest machines are self-oiling and self-aligning; in the design of which a length of four times the diameter has been adopted. The wrought iron used in the machinery built for lighting and power as well as the cast iron is run at a magnetic density below the average practice. About 10,000 lines of force in the wrought and 7,000 per square cm. in the cast iron marks the point of maximum saturatiou with them. The conductors on the machines, their radiating surface and cross-section is aptly proportioned for points of high overload.



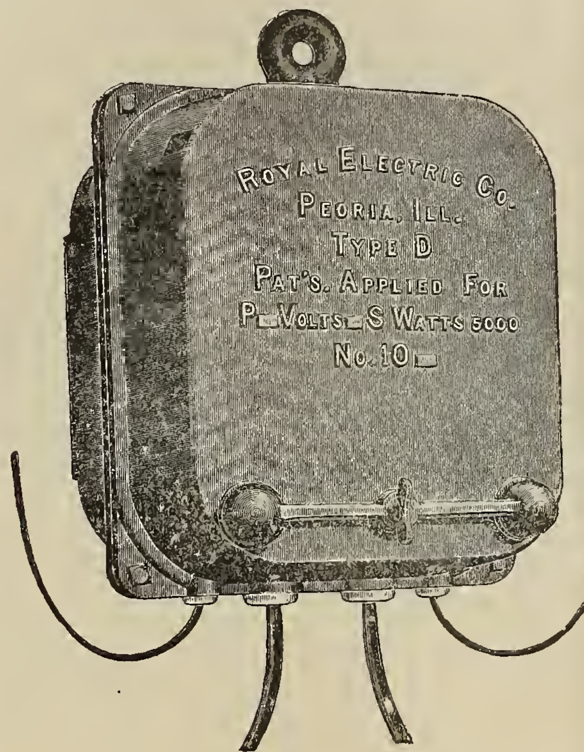
Rotary Part of Alternator.

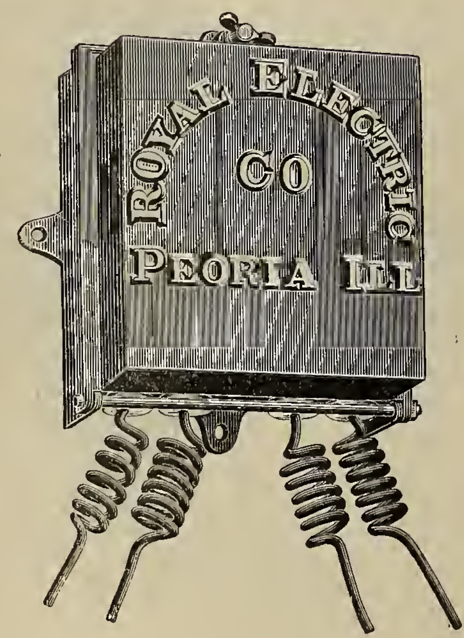


View of Laminated Armature Cores and Coils.

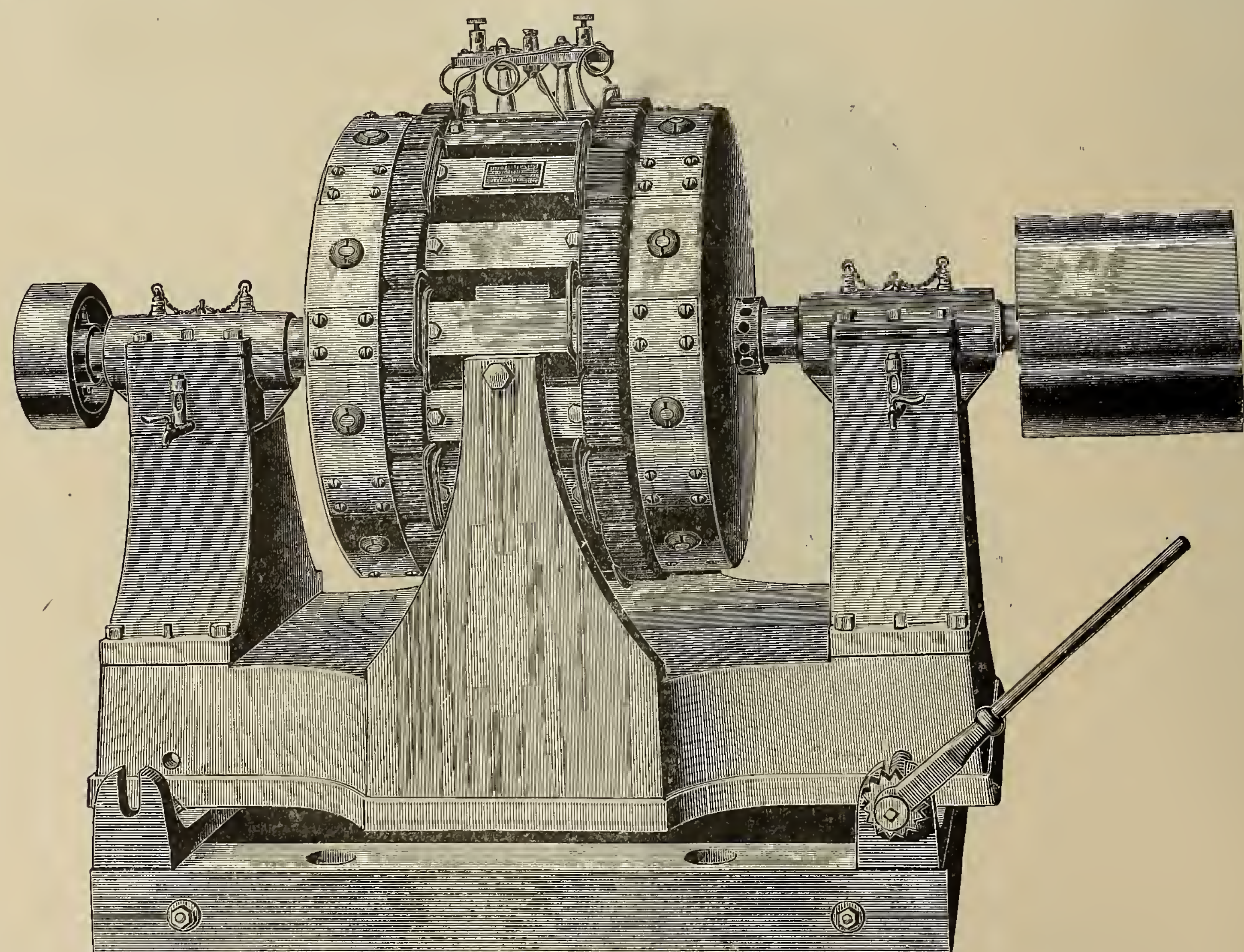
The Royal Electric Company build two classes of machinery, alternating and direct current, with the acces-

sories required for their operation. The alternator presents the following characteristics, which are unique and practical: It possesses a rotary magnet without moving wire; dispenses with high or low tension collector rings or brushes; it is designed to furnish current in one or two independent circuits, and can be used to produce a single phase or two-phase current. The alternator can be very readily repaired in case of a burn-out, and when repaired invites the expenditure of but little time or money. This is most unlikely to occur as this construction of alternator precludes such a possibility. The alternator of which we speak has a solid frame and base plate, which slides upon ways and can be moved back and forth by means of a lever operating a ratchet attached to a screw. Self-oiling bearings with oil sights are desirable mechanical features. Two pulleys are provided, a large and a small—one for the alternator itself, the other for the exciter. The exciter is of larger capacity than that required for the machine. At the full load guaranteed by the company the exciter has a reserve of one-quarter of its capacity, so that in case of greater losses on the lines or a call for a larger output for the alternator the exciter is fully capable of taking care of an excessive load. It is to this ample margin given in this and other of their apparatus that the success of their machines may be mainly ascribed. A point to be noticed in connection with this alternator is the fact that only masses of iron are rotated, and not even collector rings require attention because they are entirely absent. The exciter terminals are mounted on the top of the machines as per sketch. The





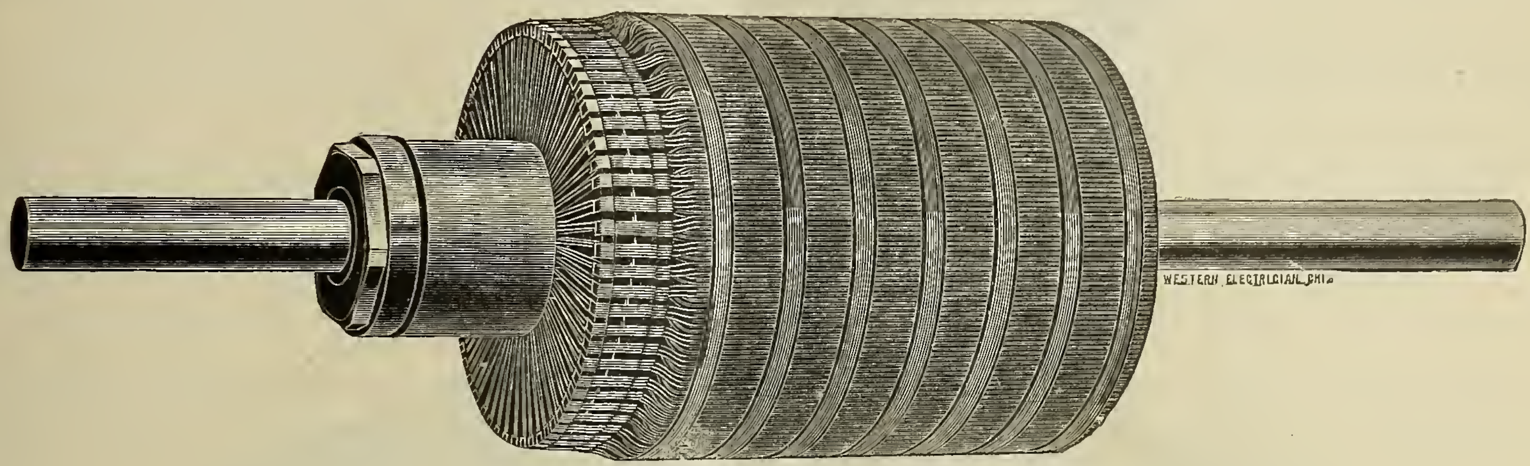
Styles of Transformers.



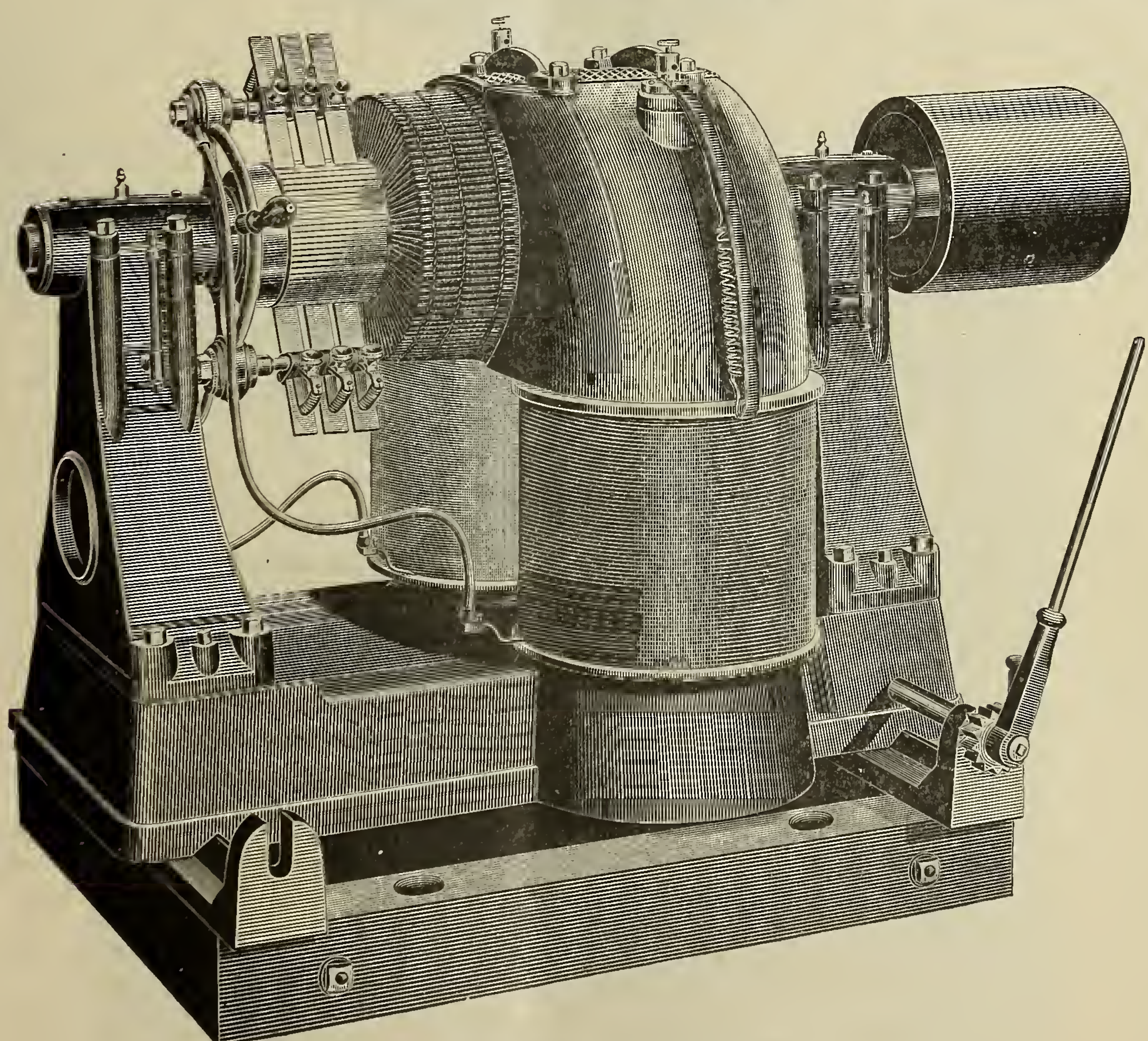
The Royal Alternator.

laminated iron armature cores, with the coils surrounding them, are likewise represented. They are supported by a cast iron spider which holds them rigidly in place. When the armature coils are all connected in series a pressure of 2,000 volts is produced. From 1,000 to 1,100 volts is the pressure generated when connected in parallel. Another sketch shows the star-shaped appearance of the end plates facing the armature coils. The extent of the field excitation is less than that of the ordinary alternating dynamo because but a single coil is used. About one per cent. of the energy developed is required for the field excitation.

Royal Electric Company represent the latest and most improved types on the market. The hysteresis and foucault current losses are reduced to a minimum by not having too high an induction and constructing them with a great number of laminæ. These transformers have removable primary fuse plugs that extend from the front of the casing to the back. They terminate in insulated handles and are quickly replaced without fear of danger The secondary is so wound that it can be connected up to give either fifty or one hundred volts. In regulation these transformers are excellent. Between no load and full load there is but a slight pressure variation and that



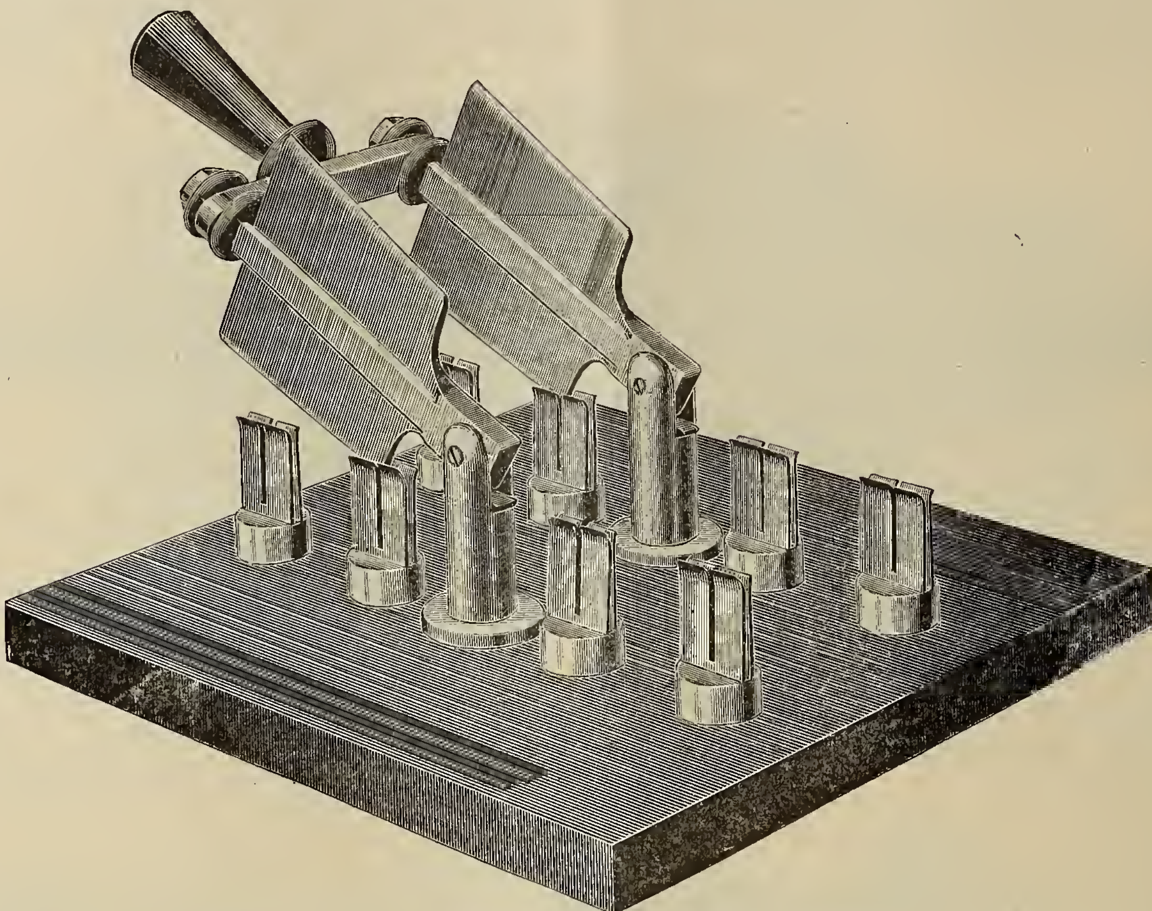
Armature of Royal Dynamo.



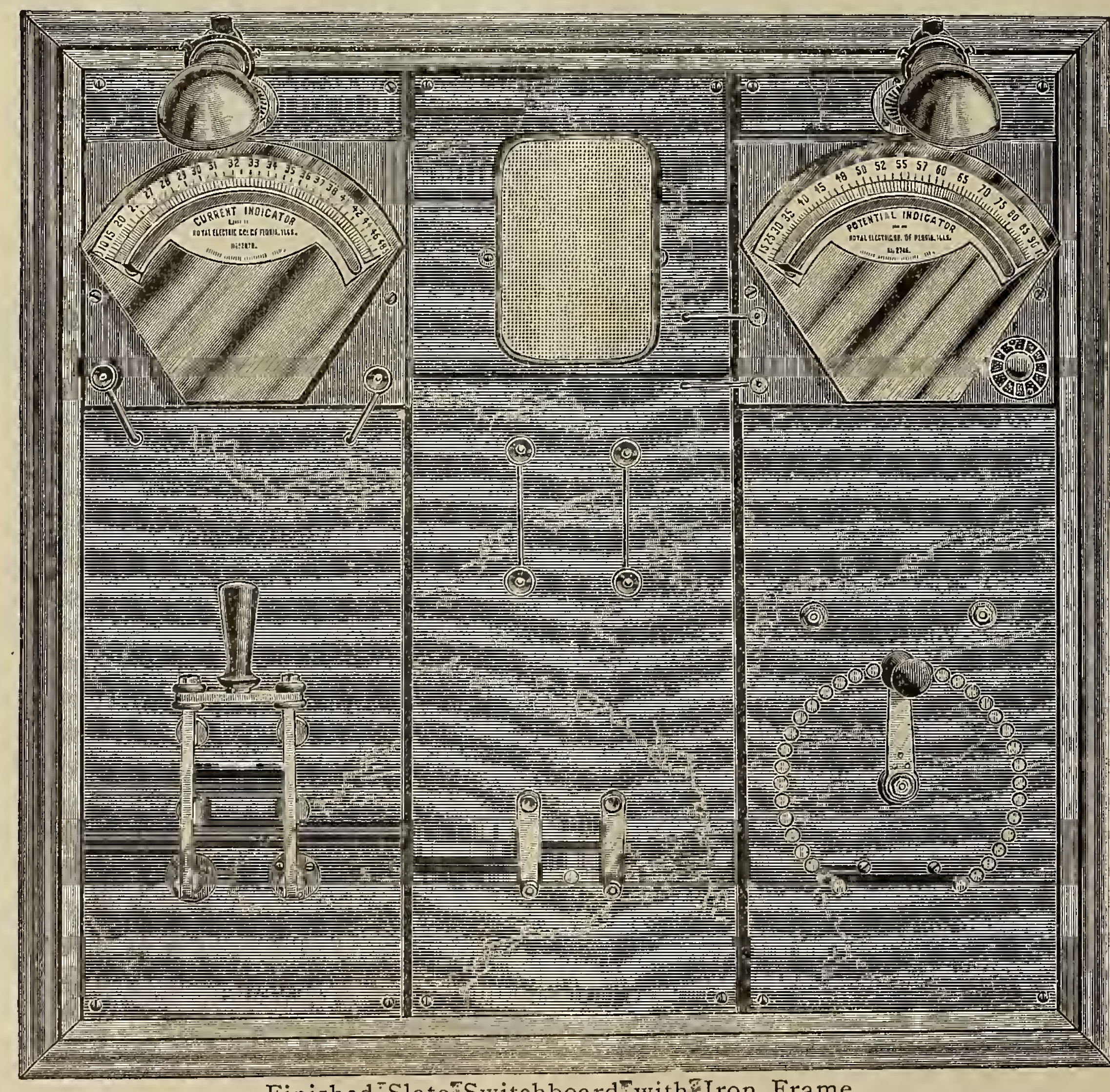
Continuous Current Dynamo.—Royal Electric Co.

It might be well to state in reference to the above that the Royal Electric Company were the first to build inductor alternators in this country. They have had them on the market since 1890. Generally speaking, their alternating apparatus may be included under the head of alternators, exciters, transformers, with their accessories, and the continuous current apparatus includes dynamos, motors, rheostats, fuse-boxes, etc. The exciter to which we have referred is supplied with a belt tightener and a sliding base as per sketch. The transformers constructed by the of a negligible character. They are built by this concern of standard frequencies but will be supplied for any special frequency desired. Their transformers for arc lighting, whose capacity for amperes varies from seven to ten to fourteen, give the following voltages: 1,000 to 30, 2,000 to 30, 2,000 to 33. The independent fuse-box constructed by this company is used in connection with the primary of the transformer. The cut shows the front view of the box closed. The four wires, two of which lead in and two lead out from the box, are connected to terminals

mounted on porcelain blocks inside the box. This box is lined inside with porcelain and contains the fuses. The two wires on the same side are connected by means of fuses mounted on a circular block the size of which is larger than the hand. This heavy block of porcelain is provided with a handle and can be inserted without injury to the operator in case of a blowing fuse. It is perfectly safe and meets with commendation wherever installed.



Double-Pole Double-Throw Switch.—Royal Electric Co.



Finished Slate Switchboard with Iron Frame.

These fuses are used on primary circuits whose pressure varies from 1,000 to 2,000 volts. The alternating current apparatus constructed by this company is unusually safe and represents apparatus of the most economical design. The direct-current system has received attention from them in the construction of dynamos and motors. They advocate them for the distribution of light and power over small areas. They are of the well-known over-pole type with self-oiling bearings. The conductors are of sufficient cross-section to stand a heavy over-load without danger. They give the best satisfaction and are solidly durable. The massive field magnets are well represented in the cut of an eight hundred light dynamo. The framework of this machine is of cast iron. In the larger machines the armatures are of the Gramme

(Continued on Page 168.)

The Electrical Age.

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CONTENTS.

THE ESCAPE FROM COMBUSTION.

If the present signs are to be believed, we are about to enter into a phase of civilized life that is as important in its outlook as that which confronted our earliest ancestors when the first flame greeted their astonished gaze.

It has been the peculiar vocation of electricians to supply this world with many of its innovations. The marvellous, mysterious and unlooked for are supposed to crop up at their feet, to be part and parcel of the atmosphere in which they live.

Yet it would be but right to award to them the palm of superiority if in the course of their scientific gyrations they were able to tear us away from the unutterably ancient practice of burning fuel.

When coal or wood or other materials are consumed for purposes of light, heat and power, there is necessarily involved in their combustion a great deal of so-called wasted energy.

For the simple production of heat, perhaps, we cannot well rebel against either the method of combustion or the practices employed for its attainment. But when it becomes necessary to obtain from fuel such as coal other forms of energy, the transformation is attended with such a lamentable loss that the inventive instincts of all thoughtful men are awakened and made keenly alive to the desirability of improving upon the present practices.

The transition from heat to other manifestations of energy is attended with considerable wasted power.

The steam engine delivers about fourteen per cent. of the energy of the burning coal from the boiler to the screw of a great ocean steamer. Almost ninety per cent. is lost. To use one pound of coal ten must be burned; this is the present economy, or, more properly speaking, "lack of economy."

Mr. Willard E. Case, in his lecture before the New York Electrical Society, on February 24, 1897, showed by experiment and description a method of obtaining electricity from carbon without heat.

In this remarkable address he pointed out the necessity of presenting the oxygen to the carbon it is to chemically combine with or the converse in an insidious and gradual manner.

It seems that an electrolyte, as defined by Dr. Oswaldt, must be supplied as a carrier for the oxygen, allowing oxidation but not combustion to occur; but by a gentle and imperceptible transition invites a combination between the carbon and oxygen without any attendant high temperature.

The idea is to keep the carbon from getting hot and depending upon that for the basis of power.

The general problem has been well stated by an able and industrious worker.

Mr. Case deserves great credit for the assistance he has given to the scientific world by his demonstration of the methods required for the heatless combustion of carbon.

A NEW METHOD OF DRIVING AN INDUCTION COIL.

In Science the following interesting bit of information appears:

Since the induction coil has come into prominence through the discovery of the X rays of Roentgen considerable attention has been turned toward devising some means which is applicable to long runs, on a voltage such as is furnished by electric light mains, 110 or 220 volts. The more recent forms of break work well with storage batteries, but these are troublesome, and a break which will work satisfactorily on the voltage of ordinary electric light mains is yet to be supplied. The following method has been devised to meet these difficulties:

A condenser of considerable capacity is first connected to the lighting mains and charged at 220 volts. It is then disconnected and discharged through the primary coil. The charging and discharging of the condenser is effected by means of a commutator. In this way the only current passing through the coil is from the condenser. The commutator is on the shaft of a small fan motor.

A six-inch Ritchie coil connected in this way with a condenser of 25 microfarads, its own condenser being disconnected, gives a thick fussy spark about two inches long. Removing the primary of the coil and replacing it by about seventy turns of rather heavy wire, number 8 or 6 B. & S., we get a multitude of fine zig-zag sparks about six inches long, the discharge being identical in appearance with that from an induction worked in the ordinary manner under the best conditions. The introduction of iron, unless finely laminated, cuts down the discharge to about one-tenth its value. Increasing the speed of the charge and discharge of the condenser up to about 2,000 per minute, which is the limit of the very crude commutator at present employed, improves the discharge of the coil in quantity and voltage. The sparking on the commutator is very slight, and the amount of power taken from the mains is small.

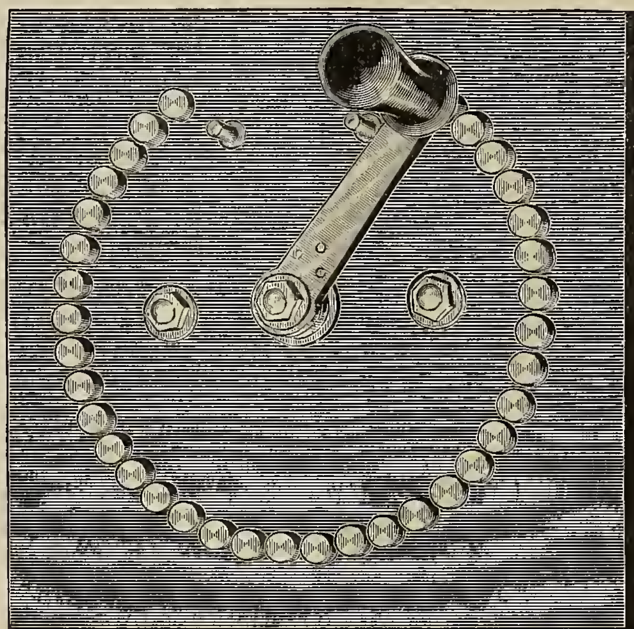
The discharge obtained in this way, so far as we can now judge, seems well-suited for driving X ray tubes. Tubes so driven give a brilliant fluorescent screen with strong sharp shadows. An exposure of twenty seconds gives a good photograph of the hand.

Chas. L. Norton,
Ralph R. Lawrence.

Rogers Laboratory of Physics, Massachuestts Institute of Technology, Boston, February 17, 1897.

The article entitled, "Conductivity of Incandescent Carbon Filaments, and of the Space Surrounding Them," will be continued in the next issue.

type; in the smaller, of the drum type. A large commutator supplies ample cross-section for the current and the brushes are pressed upon it with a finely designed spring brush-holder. Both motors and dynamos are similar in construction, being built upon the same excellent principles. The standard machines are wound for from 110 to 220 volts and are either shunt or compound wound. The motors run smoothly and noiselessly and stand sudden changes of load without the least difficulty. They neither spark nor heat and have earned for the company an excellent reputation in this particular field of work. They are made as large as seventy horse-power and of pressures varying from 110 to 220 or 500 volts.



The Rheostat.

The company manufactures their own single and double throw switches for their switchboards, as they have found it not advisable to purchase them on the open market, especially when they are to be used in connection with 2,000 and 3,000 volts. They have found that rubber insulation of ⅛-inch thickness or more is not enough to insulate for these higher voltages, and special precautions are necessary so as to be sure that the dynamo does not become short-circuited, due to defective switch design or too close a distance between the opposite terminals. It will be noticed that the contact surfaces are ample, and the material for the switches are of sufficient section.

The resistance coils, which are behind the slate front, are wound on micanite tubing and mounted on rods located behind the contact buttons, shown in front. These rheostats are made for any size of continuous current dynamos for the shunt circuit, the spools being lathe wound and easily accessible and interchangeable, being held in position by nuts on the rods. The cross-section of the German silver conductors is selected so that the current passing through them will not raise the temperature 30 degrees.

A CANAL TO DEVELOP HORSE-POWER.

A scheme to develop from 100,000 to 200,000 horse-power by building a canal from the St. Lawrence River to the Grass River in St. Lawrence County has recently come to light. It has taken long months of work on the part of the men who were pushing the enterprise to secure the necessary capital. It is now understood that they have managed to place bonds with certain English capitalists, and the work on the proposed canal will begin at once. The St. Lawrence is to be tapped two miles below the southern end of Long Sault Island, and the canal will run over a comparatively level plateau till it reaches a drop of about forty feet at Massena, on the Grass River. Here the turbines will be put in, and an electric plant will be erected to generate the horse-power. The canal will be about four miles long, 300 feet wide and 25 feet deep if it is decided to obtain only 100,000 horse-power. John Bogert, the consulting engineer, estimates the cost of such a waterway at $1,000,000.

Stewart & Co., of No. 40 Wall street, have bought up about 1,800 acres of land through which the canal will run, and will manage the enterprise. They have received prior applications for almost all the power they will generate, it is said. Lieutenant James Patton is designing the electrical plant.—New York Tribune.

A BATTERY OF TINY CELLS.

Taking advantage of the fact that no matter how small a lead storage battery is it will give the same electromotive force, Professor Trowbridge, of Boston, has had made for him a battery of 5,000 cells, each one only as large as a test tube. This battery when connected in series will, therefore, give approximately 10,000 volts, and is probably the largest in existence when pressure only is considered. Professor Trowbridge intends to utilize this battery for X-ray experimental work.—Philadelphia Record.

CANADIAN LETTER.

Rossland, B. C.—A Montreal syndicate is said to have purchased the water and light plant and franchise, and propose putting in a complete electrical system.

Quebec, Que.—The Trades and Labor Council have requested the city council to grant a contract for street lighting for two years only, at the expiration of which time it is said that the city will install an electric light plant.

Fredericton, N. B.—The city council have still under consideration the purchase of a road plant. A proposition has been made to the council to install an electric fire-alarm system.

Nelson, B. C.—A company has been organized here with a capital stock of $20,000, to put in an electric light plant. The work of the construction will commence as soon as the water rights are obtained of the government. The company will order one 5,000-light machine, step-up and step-down transformer, long distance system, that will supply 2,200 volts in town; also one 50-light arc machine. George Cassidy, of Vancouver, will probably establish a saw-mill here.

J. Alcide Chausse.

Commencing March 12th there will be an exhibition at the office of Elmer P. Morris, 36 Dey St., New York city, the Nowotny long-burning improved arc lamp. Mr. L. R. Keck, the president of the Nowotny Electric Co., of Cincinnati, O., will be in the city for a few days and will be pleased to meet buyers and explain the superior features of their lamp.

THE DYNAMO.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

BY looking back upon the past few years, the dynamo appears as a new and untrustworthy device. It was a very interesting piece of mechanism and produced a current capable of doing many wonderful things, but it was not received with confidence. Today what a change has occurred. It is a part of every large hotel equipment, a necessity to public and municipal buildings. The elevators of many tall structures depend upon it and the newest developments tend to force its application for heating our dwellings as well as supplying both light and power.

Principles.—It is encouraging to know that the principles upon which a knowledge of the dynamo is based are of a simple, uncomplex nature, and it may free the mind from doubt and hesitation to realize that even the early history of the dynamo possesses an interest which unconsciously ripens it by its preparation for the subsequent facts which follow. Not even do our efforts flag in investigating the brilliant successes of Faraday.

The work was not achieved by an individual, but by many. The seed which led to one of the greatest industries in the world was planted by a careful gardener, whose discriminating mind selected the richest soil in which to place the precious germ.

But its first growth was not very productive. It required many others of recognized genius, whose ability drew comments from their own government to healthfully develop the first idea. Edison in America, John Hopkinson in England, Siemens in Germany and Pacinotti in Italy added their portion to the accumulating heap of facts. From the very first and most elementary discovery of Faraday sprang a host of useful principles to which we owe the growth and practical utility of the modern dynamo. The elements by reference to which the action of the dynamo can be understood will be contained in the following notes.

Arago in 1824 noticed that a magnetic needle would not swing as often when near a metallic body as it would when isolated from it. Copper exercised the most striking effect, and was spoken of as being able to reduce the oscillations in a short while from 300 to 4.

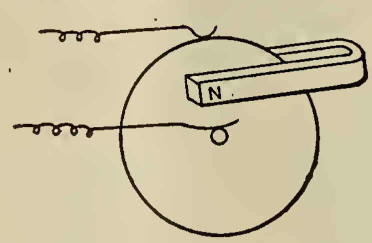
In 1825 he discovered that a plate of copper, rotated under a suspended magnet, caused the magnet to deflect in the direction of motion. Two other experimenters, Bubbage and Herschel, repeated Arago's experiment and drew up a table showing the relative effects of this action on different metals:

Copper,	100.
Zinc,	95.
Tin,	46.
Lead,	25.
Antimony,	9.
Bismuth,	2.

Faraday with characteristic genius explained these effects in a manner acceptable even to the most sceptical minds. The rotation of the magnet above the copper disk generates currents in it which react upon the magnet. The way in which they react is to destroy the swing of the needle, in the first case, or force the magnet or needle out of its customary position in the second. The law, framed by Lenz, which covers all such cases in which a magnetized body and a metallic mass move in each other's neighborhood is as follows:

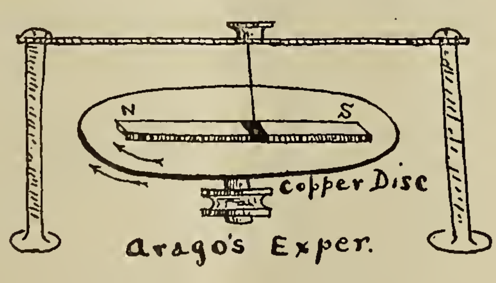
Lenz's Law.—In all cases of electromagnetic induction, the induced currents have such a direction that their reaction tends to stop the motion which produces them.

It is but necessary to appreciate this fundamental fact,



Faraday's Disc Experiment.

and the phenomenon of electromagnetic induction in all its phases appears as but a simple and reactionary effect. In fact, to some minds the presence of a current by the movement of the magnet was expected. A force cannot be applied at one point without producing some equally disturbing effect at another. Matter is simply the material by which a given amount of power is transmitted and, therefore, a swinging magnet radiating lines of magnetic force must create in the conductor they strike some such remarkable effect as we perceive. The idea of Faraday's regarding the disk of Arago took root. Faraday himself, in 1831, discovered the principle of induction; he followed the path of Arago and constructed a small dynamo. It consisted merely of a disk of copper revolving between the poles of a magnet, but it gave a continuous current and was named the Faraday disk dynamo.



Arago's Original Experiment.

Today machines are used of the same construction in some electro-metallurgical works. Noting in mind the fact that a magnet moved in front of a conductor has its motion resisted, or the converse, a conductor moved past a magnet has its motion resisted, the reason why such retardance is necessarily due to induced currents becomes pretty evident. A magnet moving through the air cannot be held any more than any other object, unless by the presence of another magnet. Neither have touched, yet they either repel or attract each other.

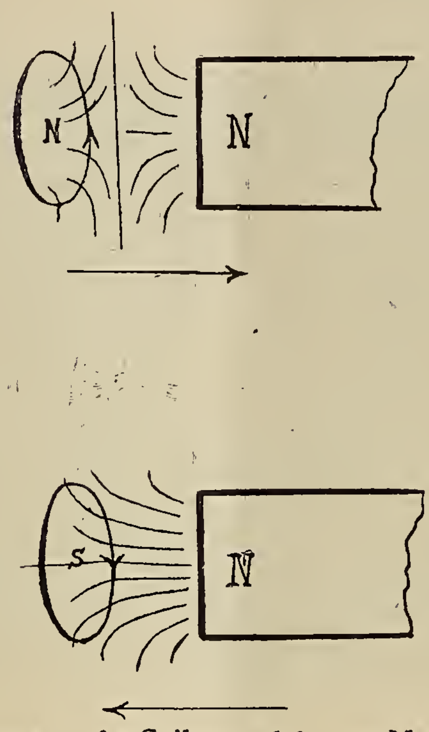
If currents are induced in a mass of metal or a conductor by a magnet, and the production of such currents

means resistance to further motion, it is highly evident that the disturbing influence is magnetic, otherwise the magnet would be unaffected. Also the currents which are reduced, and which affect the moving magnet, must hold it back when it moves away and push it away when it moves back. Any movement whatever restrained, and this restraint is investigated from these two standpoints.

(1) Motion of magnet to a coil.
(2) " " " from "

ammeter, which shows the total output of the power-house. The recording watt-meter especially is a valuable instrument, as by mean, of its readings exact records of the power-house may be kept.

The modern method of line construction is to divide the trolley into sections and connect each section separately to the main buss-bars through feeder panels, each of which contains an automatic circuit breaker, an ammeter and a switch. This method confers the advantages



Movement of a Coil to and from a Magnet.

THE MODERN POWER HOUSE.

BY RICHARD M'CULLOCH.

(Continued from Page 133.)

In the use of large direct-connected units a great deal of the economy to be gained depends upon the selecting of the proper sizes of units. The efficiency of a generator will be good when it is operated at more than 75 per cent. of its capacity, but the efficiency of an engine drops off very rapidly when it is running below its rated load. In order to achieve the best economy from the use of large direct-connected units, the sizes of the different generators should be so proportioned that it is always possihle to operate one or more units at their rated capacity. The railway generator as at present built will stand an overload of 50 per cent. for several hours without trouble and at a maximum efficiency. This should be taken into account in the estimate of the dynamos required, but it should always be the aim to have at least one idle machine to throw on the line in case of failure of any of the others. The actual size of the units depends upon the character of travel which the road possesses and the number of cars, and this must be determined for each road independently. In choosing machines, however, standard sizes should always be adopted, as this obviates any trouble in obtaining supplies and repair parts.

The railway generator switchboard has become standardized to the extent that it consists of a panel for each generator, each panel containing the usual automatic circuit breaker, ammeter, field rheostat, field-switch and main-switch. It is hardly necessary to mention that there should be nothing combustible about the board, and it is not an absolute necessity for the board to contain a marble tablet inscribed with the illustrious names of the president, vice-president and secretary. It would confer equal fame and perhaps be more economical of valuable space for their names to be handed down to posterity in some manner less electric. Switchboards as now erected usually contain a recording watt-meter and an

that trouble on the line is always indicated on the proper section, and that in case of short circuits on the line, the main circuit breakers are protected by the section circuit breakers and the load is not suddenly thrown off the engines by the opening of the main circuit breakers. Most of the generator aud feeder-boards are supplied with devices for preventing damage to the station machinery by lightning, but a very simple and effective arrangement is to connect a large water rheostat between the positive buss-bar and a good ground. This is either left in circuit continuously with a small current running through it, or is cut into circuit on the approach of a storm.

Besides those machines which are absolute necessities in a power-house, there are various devices which may be added to secure convenience and regulation. An overhead crane is installed in the engine room of most of the large modern power-houses and adds greatly to the speed with which heavy repairs may be executed. An oiling system of some sort by which the oil is either pumped or flows by gravity to the different bearings obviates the necessity of manual labor in oiling, and insures a steady feed at each bearing. A recording steam gauge is found very useful in checking up the firemen.

An air-pressure system is beginning to be used in many of the power-houses by means of which the carbon dust may be blown out of the armature windings. With this apparatus an armature may be kept thoroughly clean, and the danger lessened of short circuits occurring on account of the carbon dust between its conductors.

(To be Continued.)

Lancaster, Ky.—W. H. Wherrit, clerk, may give information concerning supplying electric lights for streets, etc.

Maxton, N. C.—A. J. Cottingham is investigating electric lighting with a view of erecting an electric light plant.

Bartow, Fla.—W. H. Towles will construct an electric light plant. Machinery has been purchased.

Savannah, Ga.—Savannah Traction Co.; $50,000 will be expended in improvements. New power house will be erected, etc.

ELECTRIC RAILWAY PROJECTS AT CATANIA.

I have the honor to send you herewith a letter to the editors of the Street Railway Journal, of New York, in response to their request for information for publication regarding concessions for new street railway lines, or such as are already in operation.

I beg to state that in a previous report to the Department, I called attention to the fact that Catania, a city of 120,000 inhabitants, has as yet no street railway, but that there were at the time several projects on foot for constructing a line of electric cars to connect Catania with its suburbs.

Louis H. Bruhl, Consul.

Catania, December 9, 1896.

[Inclosure.]

Catania, a seaport city at the foot of Mount Etna, population 120,000, does not as yet possess a street railway system, but there are a great number of common hacks, drawn by poor horses, to be found on the streets. The fare is very cheap, *i. e.*, 7½ cents for one, two, and even three persons per trip, anywhere within the city proper. Besides, there are running between the city and the suburbs a number of omnibuses, but these are rarely patronized by the better classes.

It is generally thought that an electric street car line would pay well, especially a branch running through Ognina, a suburban town along the seacoast, where, during the spring, summer, and fall, many of Catania's people spend a few months in their own or rented cottages, coming to the city during the day to attend to business. This branch, leading also past the bathing establishments, would have crowded cars during the season.

This subject has for some time been agitated in the local newspapers, and there are now on foot two projects, by two different engineers, and the promoters of both plans have applied to the municipal government for a concession, which will doubtless be granted, but to only one of them. However, as yet, the city council has not been able to come to a decision as to which of the plans and routes to accept.

One of the plans has been prepared and submitted by Engineer Virgilito, who, through the mediation of a local exchange broker, Giulio Baurettel, is seeking to induce Belgian capitalists to build and operate the line (which would mean Belgian material), but they have not yet succeeded.

The promoters of the other plan are Fratelli Prinzi, owners and operators of a large steam flour mill at Catania. It is thought to be more likely that this firm will obtain the concession.

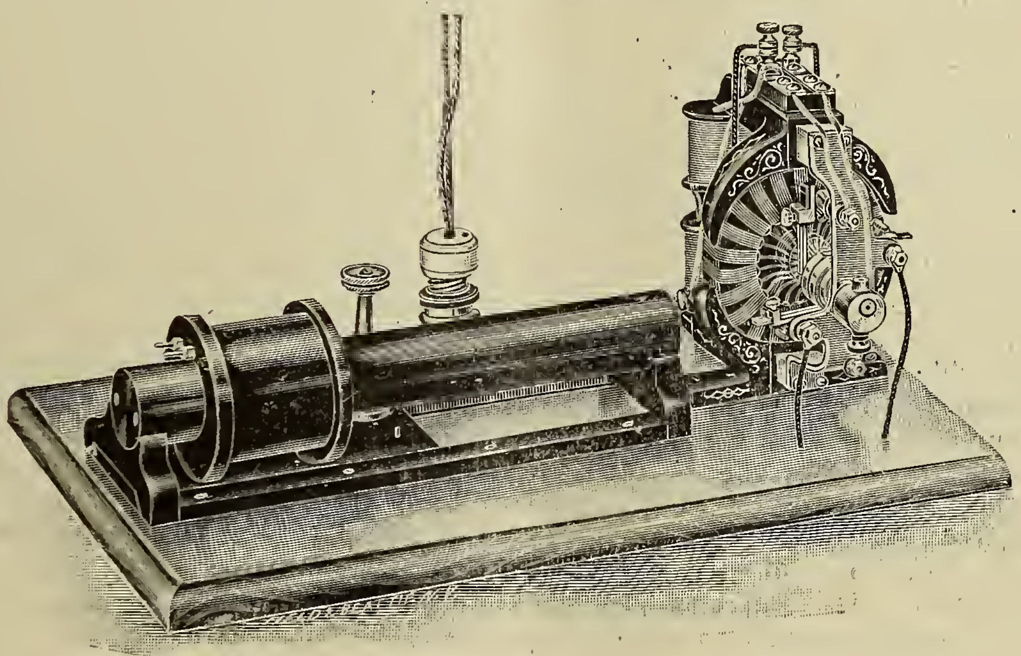
(Continued Next Column.)

THE EDISON DIRECT-CURRENT CAUTERY TRANSFORMER.

This apparatus is designed to enable the direct 110 to 120-volt Edison current to be used with absolute safety for electro-cautery work, and will be found of the greatest assistance to those physicians whose offices are equipped with this current. It is also suitable for hospital work, as nearly all of the most prominent institutions are lighted by the Edison current.

It consists of a 120-volt Edison motor, the armature shaft of which is provided with two collecting rings, which are connected to the armature at points diametrically opposed.

The current taken from these collecting rings, which is now of an alternating character, is led into the primary circuit of the transformer, shown on the left of the cut. The primary circuit is composed of a number of turns of fine insulated copper wire, wound round a core of annealed iron wires, the whole being enclosed in a thin cylindrical shell of hard rubber, which is supported by a hard rubber standard at each end. The secondary coil, composed of a few turns of thick wire, is wound on a hollow hard rubber spool, operated by a rack and pinion movement and sliding over the primary coil. The terminals of the secondary coil are brought out to two pin



The Edison Direct-Current Cantery Transformer.

attachments mounted on one head of the coil, and the cautery cords are connected thereto by split socket connections. On moving the secondary coil to the right, the current is increased and *vice versa*. The apparatus is mounted on a highly polished oak base, and is provided with an attachment plug and ten feet of flexible cord for connecting the instrument to the mains.

The apparatus is manufactured by the Edison Manufacturing Company, 110 East 23rd street, New York City.

Halifax, N. S.—The city engineer has been instructed to report on the cost of installing an electric light plant to do the city lighting.

(Electric Railway Project at Catania.—Cont.)

In order to ascertain what might be the chances for American manufacturers and capitalists, I called upon the Fratelli Prinzi, who, in reply to my questions, informed me that in case they get the concession, they intended to build the line themselves, and would not require any motive power, as they have in their mills fully 250 horsepower more than they have any use for. They would purchase the necessary dynamos, wires, poles, rails, and ten cars to start with.

ELECTRICITY FROM CARBON WITHOUT HEAT.*

BY WILLARD E. CASE.

The subject has such possibilities, all within reasonable bounds, that I hardly know where to commence or finish. At present we have only crossed the boundary line of that field which I am sure will be productive of tremendous results.

Thermo-electricity has attracted attention for a great many years past, and now and then we have heard of new inventions which led us to think that we were about to solve the problem.

As far back as 1801, Ritter noticed that a current was set up when the junctions of dissimilar metals were heated. And following down to a later date, we find that some thermo-electric batteries were constructed which really produced electrical energy at small cost, and which have been to some extent found practicable. A thermo-cell was described by the speaker before the Royal Society in 1886, which I will now show you. (Experiment shown).

It consists of plates of tin and platinum, forming the electrodes, immersed in a solution of chromic chloride. When the cell is heated, the electrolyte becomes active; chlorine, leaving the chromic chloride, temporarily combines with the tin and forms proto-chloride of tin. This chemical action generates electricity, and soon the tin is all converted into chloride and the current ceases. When the cell is cooled this temporary combination of the chlorine and tin is broken up and the chlorine returns to chromium proto-chloride. The tin being set free falls as a metallic precipitate to the bottom of the cell in the form of crystals, ready to renew the operation. If this cell works between 80 and 180 degrees F. or 538 and 638 degrees absolute, the c. m. f. at the higher temperature is about .26 volt, but the possible efficiency is less than 16 per cent., owing to the operation of the second law of thermo-dynamics, which provides that in the conversion of heat into work, the efficiency equals the higher temperature minus the lower temperature divided by the higher temperature reckoned from an absolute zero, the latter being minus 273 degrees Cent. So that this cell is a heat engine; a reversible voltaic cell which passes through a complete cycle. It must be heated to operate, and cooled to regenerate itself.

In this connection it may interest you to see in operation a more practical thermo-cell which converts heat into electrical energy. This battery is said to consume 2½ cubic feet of gas per hour, and to generate 12½ watts. (The Cox thermo generator was shown in operation, driving a fan).

In order to make the subject clear to those who are not familiar with it, let me say that all electricity (except that produced by water-power or galvanic batteries) is obtained from carbon. That is to say, our electric power of today is generated by the combustion of coal under the steam boiler, or by means of the gas engine, and through the intermediary of engines and dynamo, this energy is converted into electricity. Now, we all know that this conversion of the potential energy of coal into heat and then into work, is a most wasteful process, owing to the intervention of the second law of thermo-dynamics above referred to, and how to overcome this law and to avoid this waste is the subject under discussion tonight. Practically we only convert a small percentage of the potential energy of the coal into work, a large portion being wasted. It is not so much the inefficiency of the boilers or the steam engine or dynamo, which converts this energy into electricity, as it is the method adopted. When we burn coal under the boiler, we transform the energy of that coal into heat energy, and the moment we do this, we come in conflict, or rather become governed by, the second law of thermo-dynamics.

It is an inexorable law of nature that under the conditions in which we live, a great waste must accompany the transformation of heat into any other form of energy. To illustrate, in hot air and gas engines, a cold water jacket is usually employed and to raising its temperature is diverted the larger share of the heat. In the thermopile, the junctures must be cooled by a circulation of air or water, and in Edison's pyromagnetic generator, the iron tubes must be cooled by application of cold air.

In accordance with the second law of thermo-dynamics, the heat not lost but which we can utilize in a given case equals the difference between the high and low temperatures used, divided by the low temperature. Now, to express this more simply, there is heat, or an expansive force in everything, down to an absolute zero; but under ordinary conditions, we cannot economically use this heat in any machine below the average normal temperature in which we live. So, when once we set up molecular motion, called heat, we only use it above the normal temperature, up to that point to which we are limited by the destruction of matter. Or, as we might say, to that point at which we burn out our boilers or melt our containing vessels. And this range is but a small fraction of the total range of the heat we have produced. Lodge has shown us that the energy in a pint of boiling water, if it could be all utilized, amounts to more than half a million foot pounds, and even if the water were quite cold, and on the point of freezing, it would still contain energy of 350,000 foot pounds of work, or 1-6 of a horse-power hour in every pint. Now, coal or zinc could be burned to heat this water to a boiling point, in which case only a part of the energy between that point and freezing could be utilized, which is a small portion of the total range between the boiling point and absolute zero. But either material can be oxidized in a galvanic battery without heat and waste, and electricity produced. If we burn the coal, as Lodge has suggested, the highest temperature commonly available is that of the furnace; hence the heat should be supplied to the working substance in the cylinder at a furnace temperature. This condition is roughly satisfied in internal combustion engines, though they have many defects at present. This furnace temperature is about 2,000 degrees above absolute zero, or 1,500 degrees Fahr., and if in this engine we could cool down to 600 degrees above zero, or 110 degrees Fahr., we could have a possible efficiency of 70 per cent. of the whole,

$$\frac{2{,}000 - 600}{2{,}000} = .70,$$ that is, 70 per cent. less the friction of the machine and the loss in the conversion into electrical energy, which would bring it down to something like a possible 50 per cent. or 60 per cent. The steam engine does not even approach this. Its theoretical efficiency at 300 pounds steam pressure is 33 per cent., but in actual operation this is reduced to 25 per cent. Gas engines, internal combustion engines come nearer this ideal. In fact, Prof. Thurston states that a cannon when being fired has an efficiency of 50 per cent.†

Let it be understood that this is a law of nature; it is inevitable under the conditions in which we live. No cunningly devised furnace or feed-water heater, or cut-off or triple-expansion apparatus, or pyro-generator can save this heat. The most that any of these devices can do is to save what would otherwise be wasted, over and above that which we must of necessity lose.

Now, the question which we naturally ask, is: How are we to convert this potential energy of the carbon into electricity with the least loss?

If the boiler, steam engine and dynamo are not available for our use economically, how shall we do it? We know that the voltaic battery does not act through the transformation of heat into electricity; it produces electrical energy direct. The zinc is oxidized and the poten-

*A lecture delivered before the New York Electrical Society, February 24.

tial energy of that zinc is converted directly into electrical energy, without the production of heat. The second law of thermo-dynamics is thus avoided as no heat appears. But the cost of this zinc and the chemicals employed to oxidize it, are so expensive that we cannot afford to use them. The cheapest materials which present themselves at present to our notice are coal or carbon and the oxygen of the air. And if we could convert the energy of the coal into electrical energy direct and cheaply, we could do away with our steam motors, in time, provided the apparatus was simple and practical. Now, there is no known reason why a cheap substance may not yet be found which will act on coal and develop electrical currents in place of heat, but the general tendency of late has been to discard this method and to attempt to find some stable electrolyte or bath, which will act as a carrier of the oxygen of the air, conveying it to the carbon and oxidizing it, as zinc is oxidized in a battery, producing electricity. This electrical energy would be the equivalent of the heat energy that would be developed by the combustion of the coal in the ordinary way.

Of course, in the construction of such a cell we must be governed by the experience which we have had with the galvanic battery in which the elements of electromotive force, internal resistance, etc., are involved, and by which consequently the output of the cell is governed; such a cell must produce a large amount of energy, be simply and easily cleaned or recharged, in order to be practical. It must be as durable and as simple to use and handle as the steam boiler and dynamo are today.

It may be of interest to give you a comparative illustration of what the energy of coal does today, through the use of the steam engine, and what it would do provided we could oxidize it in a battery without heat. The average of large electric light plants requires 4 pounds of coal for every horse-power hour of electricity delivered from the dynamos to the line. That is to say, four large stations show a consumption of 4.2 pounds per horse-power hour; 49 stations, 4.6 per horse-power hour; and 32 small stations, 12 pounds per horse-power hour. Theoretically, .175 pound of coal will yield one horse-power hour; or, allowing for ash, .185 pound, and of zinc, one pound used in a battery produces one horse-power hour under a potential of 2 volts, including the loss in internal resistance. The cubes of these materials represent the weights required by each to produce one electrical horse-power hour. (Experiment shown.)

Of course the subject of electricity direct from carbon has been considered from many points of view. Some have attempted to obtain cheap electricity by using the oxygen of the air to oxidize various substances; others have attempted to oxidize coal with the oxygen of the air without heat, and others have attempted to oxidize coal by the oxygen of the air with the application of external heat. The evolution of this subject is most interesting. We will, therefore, study the question from that point of view, and examine some of the most important batteries which have been constructed. We will do so chronologically. Of course, lack of time wili compel me to avoid reference to many well conceived inventions.

Passing over the carbon-consuming cells of Jablochkoff, Bard, Crumm, Edison, Wright and Thompson, I will first describe the cell invented by C. S. Bradley in co-operation with Professor F. B. Crocker, which was mentioned in the discussion of a paper read by the speaker on "Electricity from Carbon Without Heat," in 1888, before the American Institute of Electrical Engineers.

†Science, Oct. 3, 1891.

(To be Continued).

Belleville, Ont.—A scheme has been set on foot to extend the electric railway from Belleville to Trenton, and hence north to Tweed, there to connect with the C. P. R.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—POWER FOR A DYNAMO.

Jersey City, March 5, 1897.

Dear Sir:—Will you kindly inform me how much power is required to run a dynamo for five hundred 16-candle-power lamps, or where could I find a book relating to such work ?

By the way, I would like to have a copy of the Electrical Age.

Yours, very respectfully,

359 Tonnele avenue. Jos. Ogden.

(A.)—On the basis of 10 lamps to the horse-power about 50 horse-power would be required to operate 500 lamps.

Lamps are sold, however, of different degrees of economy, some requiring more power than others to run them; therefore the following is, strictly speaking, more correct:

Watts per Candle-Power.	Horse Power.
4	43
3½	38
3	32
2½	26
1	10.7

Meadowcroft's A B C of Electricity, or Thompson's Dynamo Electric Machinery.

(Q.)—HORSE-POWER TO DRIVE CIRCULAR SAW.

Brooklyn, March 4, 1897.

To the Editor of the Electrical Age.

Dear Sir:—What is the correct method to employ to find the correct horse-power necessary to drive a certain machine under these conditions? I have a circular saw twelve inches in diameter; pulley on shaft is six inches in diameter and four inches wide; revolutions must be 3,000 per minute; heaviest work to be done to rip and cut four-inch oak lumber.

I am a constant reader of your paper and member of American School of Electricity.

Respectfully,
F. S.

(A.)—The power required for a circular saw depends upon the rate of feeding it with stock.

About three horse-power will supply the necessary energy to run saw at 3,000 with four-inch oak stuff.

(Q.)—SPARKING AT BRUSHES.

New York, March 5, 1897.

Dear Editor:—Seeing an excellent opportunity to get some information through your Inquiry Column, I beg to ask a question. I have a ¼-H. P. Lundell motor, 115-volt taking current from my dynamo. I wanted the motor to run in an opposite direction, so I reversed the field wires and it did so, but I have a great deal of trouble with bad sparking and every four or five days I have to renew the brushes. How can I overcome this?

P. S.—It runs a 22-inch exhaust fan.

Very respectfully yours,
A. F., Electrician,
Care of James McCreery & Co.,
64 and 66 West 23rd street.

(A.)—Adjust the brushes to neutral line. Set brushes so that they be within the pole corners.

Motor is possibly overloaded.

CHANGE IN LIGHTING.

Hugh Glenn & Co. to Have a New System of Electric Lights in Their Store.

Before the end of this week it is expected there will be an entire change in the lighting system of the stores of Hugh Glenn & Co.

The firm's plant consists of a 120-horse power boiler and a 100-horse power engine, which propels two Edison dynamos, each with a capacity of 160 amperes, equalling 640 lamps of 16 candle-power each.

Out of the whole 640 incandescent lights 100 of them will remain in use, and they will be in the basement. The other 540 will be displaced by arc lamps of 2,000 candle-power, each using the same amount of current as now.

The new lamps are known as the "Manhattan" and are enclosed arcs. They differ from the ordinary arc lamps in that the carbon burns in a partial vacuum and thus makes the life of the carbon longer, as the ordinary arc lamp carbon burns seven hours and these burn 150 hours. The arc is enclosed in a glass case about six inches in length and three inches in diameter at the largest part, and are made air-tight at the bottom; covers fit over the top through which the carbon feeds.

The lamps are connected singly on the circuit instead of two in a series, as the open arc lamps are. This is an advantage, as each lamp can be turned on or off at will. It consumes about five amperes of current at 80 volts. A resistance is placed in a canopy, reducing the voltage of the line to that of the lamp. It is adjusted to burn on any circuit from 100 to 125 volts potential.

One of the very important points in favor of this light is that by entirely closing the arc in an inner globe there is no possible danger from sparks, and as all carbon dust is consumed a cleanliness is secured which would be impossible in open arc lamps. Another advantage is that the light is evenly and perfectly distributed, completely filling the globe with a clear and steady white light, casting no shadows, and the annoying flickering and noisy fluttering are entirely done away with.

Hugh Glenn & Co. have made a thorough test of different kinds of lights, and were so well pleased with the one adopted that they decided to take out the incandescents and replace them with arc lamps. Arthur Kassing, the engineer, who has charge of the entire plant, tried the different lights and approves of the one adopted, as it is more economical, gives a brighter light and is easily cared for. (Utica Daily Union, February 22, 1897.)

POSSIBLE CONTRACTS.

Wheeling, W. Va.—City Clerk may give information concerning electric light plant.

New Orleans, La.—The Traction Company will erect new office building.

St. Clair, Mich.—The new Dyar electric road survey is now in progress.

Port Huron, Mich.—Work on the construction of an electric road will commence immediately.

Kansas City, Mo.—The old Union cable line has been purchased by F. B. Dickson, who will convert same into an electric road.

Salisbury, Md.—An electric fire-alarm system is to be established. Bids are being invited for same.

Newburyport, Mass.—The Haverhill, Merrimac, Amesbury Street Railway have been granted permission to erect poles and equip with electricity a branch of the present system now operated by horses, from Salisbury Square to the New Hampshire line.

New Brighton, Pa.—S. P. White and others are interested in scheme for the erection of an electric power plant.

Xenia, Ohio.—An electric road will probably be constructed from Wilmington to Dayton, by way of Xenia, a distance of about 33 miles.

St. Louis, Mo.—Robert E. McMath, president Board of Public Improvements, can give information concerning lighting streets of city with incandescent and arc electric lights.

Winchester, Mass.—The Winchester and Arlington Electric Road; application granted by selectmen.

New Bedford, Mass.—The Brockton, Bridgewater and Taunton Street Railway Co. have purchased rails for trolley line construction.

Lawrence, Mass.—The Lawrence and Reading Street Railway Co. have been granted franchise to construct electric road from Lawrence to Boston.

Greenfield, Tenn.—Steps are being taken to establish an electric light plant.

Jonesboro, Tenn.—Town Clerk may be addressed for information concerning establishment of an electric light plant.

Jacksonville, Fla.—Jacksonville Electric Light Co.'s new electric station is being erected on Hogan's Creek, at the head of Washington street.

Demopolis, Ala.—The Demopolis Electric Light and Power Co. will establish an electric light plant of twenty-five arc lights and 600 incandescent.

Owensville, Ind.—Town Clerk may be addressed for information concerning the construction of an electric light plant.

Gardner, Mass.—The Gardner, Westminster and Fitchburg Electric Railway will probably be constructed in the spring.

NEW CORPORATIONS.

Idaho Springs, Colo.—The Idaho Springs Electric Light Co. has been incorporated by Frederick A. Moss, Jacob J. Elliott, Henry Plummer and James H. Ireland. Capital stock, $30,000.

Commerce, Tex.—The Commerce Improvement Co. has been organized with W. W. Rutland, president; O. C. Mulkey, secretary, and W. J. Taylor, treasurer. The company will build an electric light plant, etc. Capital stock, $50,000.

Albany, N. Y.—The Depew and Lancaster Power and Conduit Co. incorporated by John N. Scatcherd, J. Hunsicker, George S. Teller, William B. Rogers and Martin Carey, of Buffalo; for the purpose of supplying gas and electricity in the towns of Depew, Lancaster and Cheektowaga. Capital stock, $20,000.

Columbus, Ohio.—The Dayton and Western Traction Co. has been incorporated by Charles L. Kurtz, Dr. J. E. Lowes, Robert M. Nevin, Oscar G. Sheppard and J. T. Feight; to build an electric road from Dayton, west to the state line. Capital stock, $400,000.

Harrisburg, Pa.—Binsboro Electric Co., of Berks County, has been incorporated with a capital stock of $6,000.

New Britain, Conn.—The Central Railroad Co. has been incorporated to construct an electric road.

Interchangeable mileage is a subject in which all commercial men and the travelling public in general are interested. The Home Magazine for March contains a symposium on the subject, consisting of the views of the representative commercial travellers' organizations of the country, as expressed by their officers. It makes very interesting reading, and as such will be welcomed by the travelling men of our nation. There are nearly half a million of them.

The Fischer Foundry & Machine Company, of Pittsburgh, Pa., builders of the "Fischer" single and four-valve engines, desires to contradict certain unfounded reports that have been in recent circulation to the effect that the manufacture of engines has been discontinued by the company. On the contrary, it may be stated that additional features have been introduced, which combined with the already known merits of the original makes of these engines, especially adapt them for electric and street railway purposes. An inspection of the company's shops in Pittsburgh reveals a thriving and prosperous industry, and the business outlook for 1897 is flattering. Foster & Louis, general Western agents, have offices at 1,000 and 1,002 Fisher Building, Chicago, where the many friends of the Fischer engine, and in fact all visitors, will be cordially welcomed.

The following announcement was recently received at this office, and we take pleasure in recommending the company to our readers:

ANNOUNCEMENT.

Having been in the electrical business for the past ten years we desire to call the attention of our friends and the trade in general to the Eastern Electrical Supply Co., No. 26 Cortlandt street, New York, which we have organized for the purpose of carrying on an electrical supply business in all its branches, and can promise, should you favor us with your business, that all orders will have our personal and prompt attention. We are prepared to execute orders at the lowest possible prices.

Thanking you for past favors and trusting for a continuance of same,

We are, yours very truly,

EASTERN ELECTRICAL SUPPLY CO.
B. H. Ellis, president and manager.
C. P. Scott, vice-president and secretary.
C. I. Hills, treasurer.

The Queens Insurance Company Building, corner of Cedar and William streets, New York, is being wired for 2,000 lamps by Mr. J. L. Chapin, No. 50 East 20th street. The Walker Company are installing the dynamos. Mr. Chapin has fine show rooms, and his offices and reception rooms are always open for business. His early experience has made him one of the oldest and ablest men in the business.

ALCATRAZ ELECTRICAL COMPOUND.

Mr. C. P. Williams, of 39-41 Cortlandt street, N. Y., is sole agent for the Alcatraz Electrical Compound. This is neither affected by changes in heat, acids, alkalies, or climate.

It possesses valuable mechanical properties, such as great strength and elasticity. This particular compound is highly desirable for wire insulation, dynamos and motors, storage battery shelving, switchboards, etc.

For underground cables it forms an excellent protective coating, and for poles, cross-arms, etc., it is of the greatest benefit. *Samples furnished upon request* by Mr. Williams, sole agent, U. S. A.

ELECTRIC STOCK QUOTATIONS.

	Bid.	Asked.
Allegheny County Light Co.,	100	—
Brush Electric Company,	—	40
Bridgeport (Conn.) Elec. Light Co.,	35	38
Eddy Electric Mfg. Company,	—	19
Edison Illg. Co. (St. Louis),	1	1½
*Edison Elec. Illg. Co., New York,	105¾	106¼
Edison Elec. Illg. Co., Brooklyn,	98	99
Edison Ore Milling Co.,	7	10
Edison Elec. Storage Company,	28	29
East End Electric Light	—	10
Fort Wayne Electric Company,	⅞	1
Ft. Wayne Elec. Co. T. Sec. Series A,	2	3¼
General Electric Company,	34¾	35¼
General Electric Company pf.,	75½	77
Hartford (Conn.) Elec. Light Co.,	105	—
Hartford (Conn.) Lt. & Power Co.,	—	15
Interior Conduit & Insulation Co.,	—	—
New Haven (Conn.) Elec. Lt. Co.,	145	—
Narragansett (Prov. R. I.) Elec. Co.,	81½	82
Rhode Island Elec. Protec. Co.,	110	122
Toronto (Canada) Elec. Light Co.,	125	132
T.-H. Elec. Co., T. Secur., Series D,	3½	4
Thomson-Houston Welding Co.,	5	—
United Elec. Lt. & Power Co.,	5	—
Woonsocket (R. I.) Electric Co.,	100	109
Westinghouse El. & Mfg. Co., pf.,	50½	51½
Westinghouse El. & Mfg. Co., assd.,	24¼	25½

*Ex dividend.

The Electrical Age.

VOL. XIX., No. 12. NEW YORK, MARCH 20, 1897. WHOLE No. 514

The Searchlight Testing Tower at the Schenectady Works of the General Electric Co.

Fig. 1 —Searchlight Reflector.

SEARCHLIGHTS FOR MARINE USE.

The use of electric searchlights on board vessels, not only of the navy but also those of the merchant marine as well as on yachts has, within recent years, been steadily growing, as improvements in the mirrors and the operating and controlling mechanism have given to the owners and the government reliable projectors. All the fine war vessels of the new fleet, the ocean, Sound and lake steamers, are fitted with searchlights of tremendous power and range, and almost every steam yacht with any pretensions is equipped with its pilot-house projector. The searchlight in the navy is the night-heliograph, so to speak, and beyond its main use to show the whereabouts of an enemy's attacking boats, or the equipment and lay of an inimical coast, its value for signalling purposes cannot be overestimated. The magnificent spectacle of the searchlight beams, as the signal codes of the war ships gathered in New York Harbor on the occasion of the Columbian festivities were run over, will remain an unforgotten incident in the minds of all to whom it was vouchsafed.

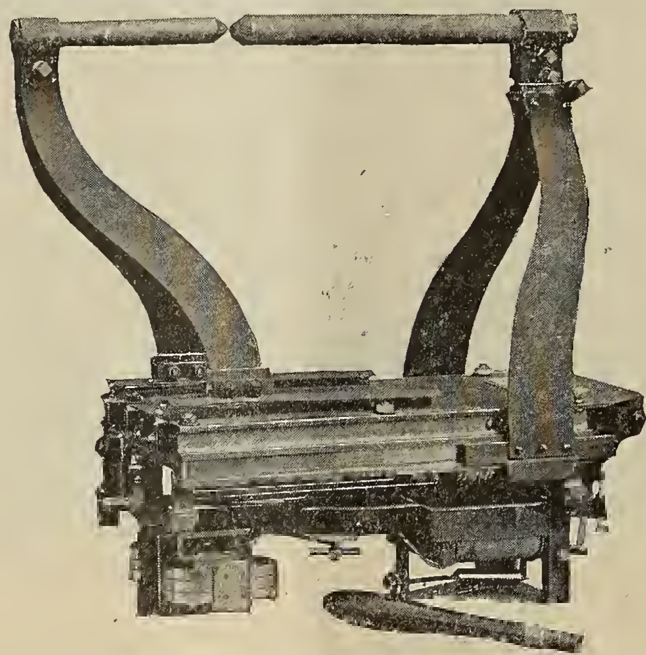
In the manufacture of a perfect searchlight are two main parts, each of which must in itself be perfect—the lamp and the reflecting surface—and unless the greatest of care is given to the design and workmanship of the first, and the grinding and polishing of the mirror, the result must be failure or only semi-success. The former requires electrical and mechanical knowledge of the highest grade, the latter grinding and polishing machinery operating with mathematical accuracy. Up to quite recently the mirrors for searchlights manufactured in this country were imported from Germany and France, at considerable expense; but when the General Electric Company decided upon the manufacture of the projectors on an extensive scale, it cast about for a manufacturing optician who could be trusted to develop mirrors of as high a grade as those of European make. A firm was found, but it took three years of the most painstaking experiment to bring its mirrors to the necessary degree of perfection. To-day the mirrors used in the projectors of the General Electric Company are of American manufacture and are equal, if not superior, to those which it had hitherto imported, and it is for that Company alone that these splendid examples of the optician's art are made.

At Schenectady, N. Y., one entire department of that company is occupied in the manufacture of projectors. It is located in building No. 23, on the northwest corner of which a square tower has been erected carrying a railed

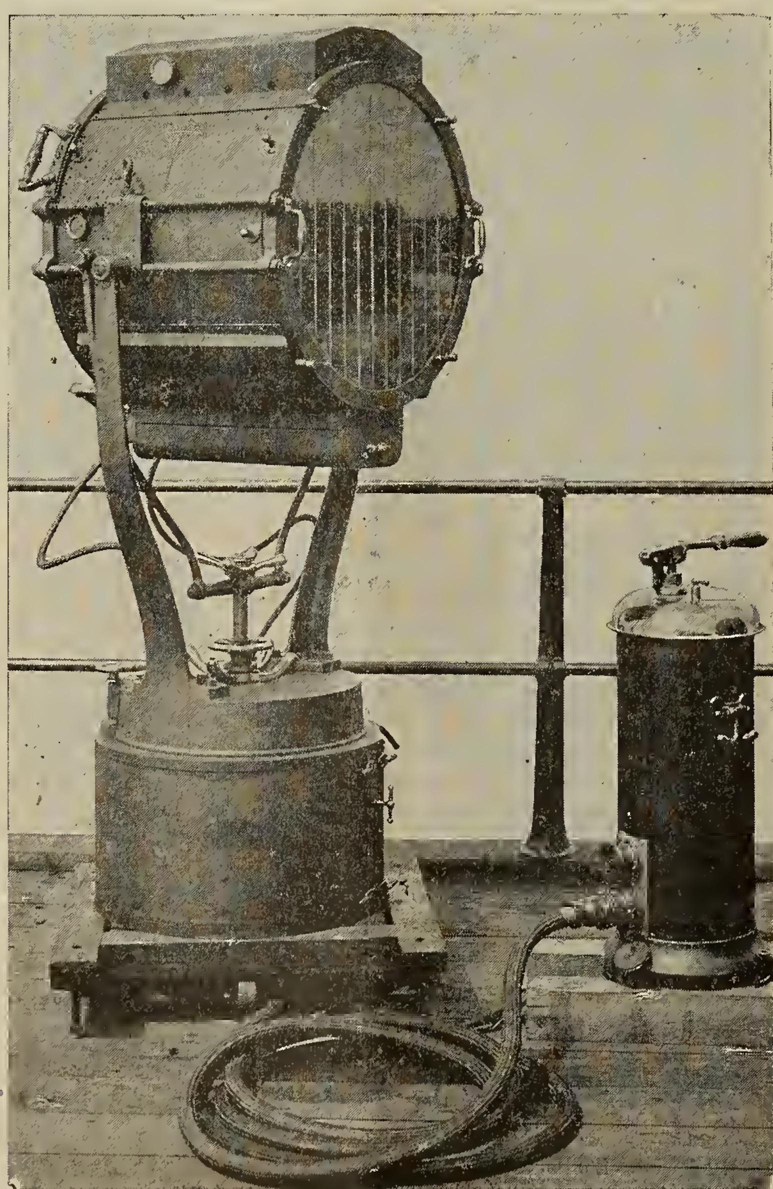
platform. It is from this that tests are made of the power and range of the searchlight beams which sweep over the wide expanse of the valley of the Mohawk. A system of distance and intensities has been calculated by which the carrying power of the beam is gauged and the capacity of the projector tested.

The light-reflecting surface is a silvered-glass concave lens, so ground that when the arc of the lamp is in its focus the reflector beams which proceed from the mirror are parallel. Two types are used—the Mangin and the parabolic; the former having two spherical surfaces of different radii, the reflection and refraction causing the rays to be projected in straight lines; the latter having true parabolic surfaces. Still a third type is used where the illumination of a large area at short range is desired—the hyperbolic, but in this case the mirrors are of metal, silvered.

The lamps are of two types, the inclined and the horizontal, according to the position occupied by the carbons. Both lamps are automatic and focus in feeding. The first type is used in the 12-inch projector, either type in the 18-inch, while for larger sizes the horizontal type has been found the most suitable. All the lamps are designed to operate on direct-current incandescent circuits, a regulating rheostat being connected in series with the lamp to bring the voltage to that point at which the best results can be obtained, which is from 40 to 60 volts, according to the current taken.



Horizontal Searchlight Lamp.



Electrically Controlled Searchlight.

In order that the person controlling the direction of the beam may most satisfactorily direct it, three systems of control have been devised, pilot-house, rope and electrical, depending upon the location of the projector.

The electrical control can be applied to any size, but is more suitable to the 24-inch and larger sizes. Horizontal

and vertical movement of the drum containing both lamp and mirrors is given by two small motors concealed in the pedestal at base, and controlled by a single lever set on a small pedestal containing the resistances and switches. By throwing certain disengaging clutches, the electrical control may be cut off and the projector be controlled by hand. Electrical central allows the projector to be operated from a point almost any distance from it. The same result may almost be attained at less cost by means of the rope control, horizontal and vertical movement also being attained by the movement of a single lever. In this case, however, the distance between operator and lamp must necessarily be limited.

When the projector is set on the pilot-house of a steamer, pilot-house control is usually employed, the actuating rod passing down through the roof of the pilot-house and terminating in a lever, movement of which gives the necessary horizontal and vertical deflection to the beam.

Hand Controlled Searchlight.

The solid beam of parallel rays has its own special use in throwing an intense light upon a restricted space. If is, however, sometimes necessary to illuminate a very much larger space, and, instead of a beam to project upon it, a horizontal band of light; this is effected by diverging lenses, set in a frame similar to that of the plain glass door, which it replaces when occasion arises for its use.

To allow of observation of the arc from outside without exposing the eye to the blinding glare from the mirror, each projector has a prism let into the side of the drum carrying both lamp and mirror. Through this prism the arc may be observed and regulated. The heat generated by the burning carbons is carried off through ventilators let into the drum at the top and bottom.

The standard sizes of these searchlights are based on the diameter of the reflecting lenses, 12, 18, 24, 30, 36 and 60 inches. The greatest searchlight in the world, that exhibited by the General Electric Company at the Chicago Exposition, was of the latter size. This light is now placed on the top of Mount Lowe, in California, whence its beams are visible many miles over the waters of the Pacific.

Destruction of the Cox Laboratory.—The laboratory of Mr. H. Barringer Cox, in St. Albans, England, was gutted by fire recently. Everything was consumed, the loss being estimated at $35,000. We extract the following from the St. Albans Advertiser and Times:

"Not for some time has there been a more disastrous fire in the city than that which took place in the early hours of Tuesday morning at the Cox Laboratory, London road, involving its total destruction. The work carried on there was very naturally the subject of much interest, and a number of visits had been paid to the building by well-known local gentlemen, and by gentlemen from London and other places. In fact it was early seen that the operations of the Cox Thermo Electric Company, Limited, of which Mr. H. Barringer Cox is managing director, were of considerable importance, and the experiments were consequently watched with keen interest. Mr. Cox, a gentleman of acknowledged ability as an inventor and an electrician, has during the time he has been settled at St. Albans, worked extremely hard to successfully establish another valuable local industry. Therefore the news that the building and its contents had been otally destroyed by fire, occasioned widespread regret."

The Costliest of the Earth.—What is the most expensive product of the world? It is charcoal thread (filament de charbon), which is employed for incandescent lamps. It is, for the most part, manufactured at Paris and comes from the hands of an artist who desires his name to remain unknown in order to better protect the secret of manufacture. It is by the gram (15 1-2 grains) that this product is sold at wholesale. In reducing its price to the basis of pounds, it is easily found that the filaments for lamps of 20 candles are worth $8,000 per pound, and that for lamps of 30 candles they are worth $12,000 per pound. The former have a diameter of twenty-thousandths of 1 millimeter (1 millimeter equals 0.0394 in.), the latter four and one-half thousandths of a millimeter. The filaments for lamps of three candles are so light that it would require nearly 1,500,000 of them to weigh a pound. As the length of each of them is 10 centimeters (3.937 inches), their total length would be 187 miles.—Inventive Age.

CONDUCTIVITY OF INCANDESCENT CARBON FILAMENTS AND OF THE SPACE SURROUNDING THEM.

(Continued from Page 149.)

Professor Fleming read a most elaborate paper before the Physical Society of London, in March, 1896, upon this same subject. Professor Fleming's experiments proved that in well-exhausted lamps the vacuum is not a conductor in the ordinary sense of the word, and that the current which passes through it is carried by negatively charged molecules, which pass constantly from the negative leg of the incandescent filament to the positive leg and to any inserted wire, thus bringing the inserted wire to the same potential as the negative leg. Professor Fleming also proved that these molecules pass in straight lines, and that their passage is completely or almost completely stopped by a glass or mica screen placed between the negative leg and the inserted wire. The following experiments serve to illustrate these effects:

Figure 5 shows a lamp having a glass tube surrounding one leg of the filament, and a wire sealed in the side of the bulb, which projects into the center of the vacuous space. When the leg of the filament which is in the glass tube is made positive, and the filament heated to about a 2 1-2 watts per candle temperature, the galvanometer, which is connected between the wire and the positive lamp terminal, shows a strong deflection, but when the leg in the tube is made negative the galvanometer, being as before connected between the wire and the positive lamp terminal, shows no deflection.

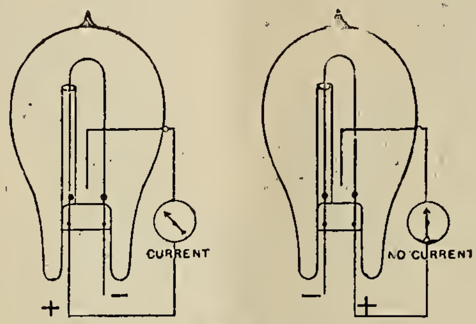


Fig. 5.

Figure 6 shows a lamp having a platinum plate 2 1-4 inches long and 3-4 inch wide between the legs of the filaments, and a wire inserted in the vacuous space. I also used lamps having a similar plate made of glass, similarly placed. In both of these lamps, when the vacuum was high, no current was produced between the wire and the positive terminal when the wire was shielded from the negative leg; but shielding the wire from the positive leg made no hindrance to the passage of the current. The facts that no current flows when the galvanometer is connected between the negative terminal of the lamp and the inserted wire, and that a shield between the positive leg and the inserted wire has no effect upon the current, show that positively charged molecules are not emitted by the positive leg; while the screen effects just described show that the negatively charged molecules pass in straight lines.

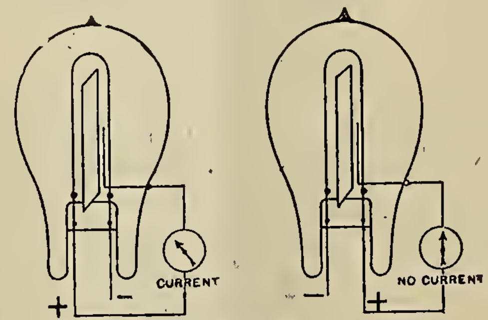


Fig. 6.

The facts, then, are these: The galvanometer indicates a current flowing, as we designate the direction of currents, from the wire to the negative leg; while experiments prove that the charged molecules which carry the current actually pass from the negative leg to the wire. These facts are entirely in accord with the results obtained by Crookes and others in their investigations of currents in high vacua.

If an alternating current is used to render the filament incandescent, the galvanometer will indicate a current with the connection made to either lamp terminal, because both are equally positive. The current thus produced is a uni-directional one in the galvanometer, and illustrates very well the uni-lateral conductivity between the incandescent filament and the wire.

Fig. 7.

Mr. Preece states in his paper that lamps which show a blue glow in the vacuous space give stronger "Edison Effects" than those which do not show it. Professor Fleming also observes that poorly exhausted lamps give slightly greater effects, but neither of them paid much attention to these lamps.

The blue glow in lamps has long been associated in my mind with a condition of the vacuum which makes it a conductor. Lamps in the process of exhaustion, just be-

fore the vacuum is perfected, show this blue very plainly, if a little more than normal current is sent though the filament. The blue increases as the current is increased and becomes very dense at very high temperatures. This blue indicates a current passing from one leg of the filament across the vacuous space to the other leg.

I observed several years ago that, at a high temperature, .04 or .05 of an ampere more current flowed though a lamp showing a good blue than through the same lamp, at the same voltage, when the blue had disappeared. I concluded that this extra current flowed through the vacuous space between the legs of the filament.

If a direct current about 20 or 30 per cent. greater than the normal current be passed through a lamp filament when the vacuous space shows a blue glow, the positive joint between the filament and the platinum wire gets red hot, while the negative joint remains cool.

I have always considered this as proof that the resistance to the passage of a current through a vacuous space was chiefly at the surface of the positive electrode, as the energy was chiefly developed there. If an alternating current is used, both joints get equally hot.

If a lamp be burned at normal incandescence with a direct current, when the vacuous space shows a good deal of this blue, the negative leg of the filament becomes coated with a carbon soot. This effect can be obtained in a few minutes if the blue is dense and the filament is run above a normal incandescence. This I have considered to be due to an electrolysis of a hydro-carbon gas in the lamp.

The lamps which show only a slight amount of this blue glow, if burned at normal incandescence, will not show this carbon soot perceptibly, and the blue will entirely disappear if the lamp is burned for a few hours. This blue is caused more by the character of the residual gas than by the degree of exhaustion. Lamps having a residual of bromine vapor do not show it at all, neither do they show any "Edison Effect." I have seen ordinary lamps ready to be sealed off the pumps which showed blue and then no blue, and blue again, at regular intervals of a few seconds. Such lamps show corresponding changes in the "Edison Effect."

If the current be gradually increased in a lamp which shows good blue, the positive joint will get hotter and hotter and finally its platinum wire will fuse. At this stage the resistance to the flow of current across the vacuous space is not great, and if the conditions are such that at this time all the resistance in circuit with the lamp has been cut out, so that the current flowing will be practically determined by the resistance of the lamp and the leads, enough current will flow through the vacuous space to fuse the platinum wires, which are sealed in the glass. This fusion is not due to the same cause as the fusion of the positive joint wire by the vacuum current, because it fuses both positive and negative wires, while the vacuum current fuses only the positive. This fusion of both wires is due to the fact that the low resistance of the vacuous space allows more current to pass than the platinum wire can carry. This is further demonstrated by the fact that a 10-ampere fuse in the circuit will often blow when this happens.

In order to measure the currents which pass from one leg of the filament to the other across the vacuous space, I measured the current at a given voltage of a number of lamps; first when the lamps showed a good dense blue, before they were well exhausted, and again after the same lamps were well exhausted and showed no blue. Some 55-volt 24 C. P. lamps showed .4 of an ampere more on the first reading than on the second. All of this .4 of an ampere must have passed through the vacuous space, for the resistance of the filament remained practically unchanged or became a little lower during the operation.

I also measured the currents which passed across the vacuous space, when these currents were large enough to fuse the joint wire, and also when they were large enough to fuse both platinum leading-in wires. I found that from one to five amperes passed across the vacuous space when the positive joint wire only was fused, and that when both wires leading through the glass were shattered, the current measured from 10 amperes to more than 25 amperes.

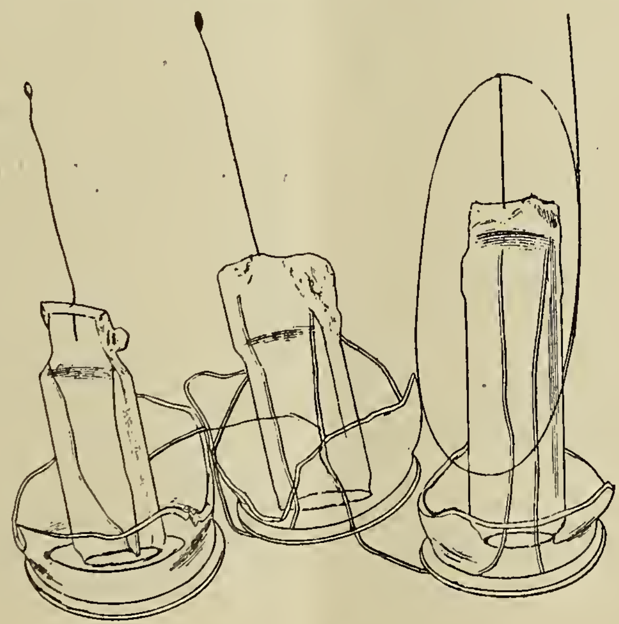


Fig. 8.

In order to measure the instantaneous current which shattered the glass, I raised the hand of the ammeter to successively higher points, to find the mark at which the current would just raise the pointer. I used an ammeter measuring 25 amperes, and when the pointer was raised to the 25 ampere mark the current through the vacuous space caused it to jump beyond this mark.

Figures 7 and 8 show stems of lamps exhibiting the effects of currents of from one to 25 amperes passing through the wires and the vacuous space. The glass about the wires shows the fusing effect of the current, and the fracture of the glass shows the effect of the expansion of the wires by the heating effect of the current. The undisturbed condition of the glass between the two leading-in wires shows that the current did not pass across the glass, but must have passed through the vacuous space. Gradations of current from one to 25 amperes, used in this experiment, were obtained by regulating the amount of resistance in the circuit when the experiments were made. Unless some resistance had been left in the circuit, all of these lamps would have shown currents as high as 25 amperes or thereabouts, because the conductivity of the vacuous space increases very rapidly when the effect is great enough to start the fusion of the wires.

(To be continued.)

(Q.)—SAFE-CARRYING CAPACITY.

Baltimore, Feb. 28, 1897.

Editor of Inquiry Column.

Dear Sir:—What general rules may be followed out in winding a magnet? Also what figures can you give me for practical use on the safe-carrying capacity of line wires?

You will greatly oblige by answering at once.

Yours respectfully,
Ralph Somers.

(A.)—Allow 1,000 circular mils per ampere for coils. For exposed line wires follow this list:

B. & S.	Amperes.
0000	312
0	185
3	110
6	65
12	23

Guelph, Ont.—The by-law to provide funds for the purchase of an electric light plant was defeated by the ratepayers.

Southampton, Ont.—The by-law to the Saugeen water-power to install an electric light plant has received the sanction of the ratepayers.

Mooresville, N. C.—George C. Goodman can give information concerning erection of an electric light plant.

Albany, N. Y.—The Glens Falls, Sandy Hill and Fort Edward Electric Railroad has filed a certificate of extension of its road across the bridge over the Hudson River at Glens Falls to South Glens Falls with the secretary of state.

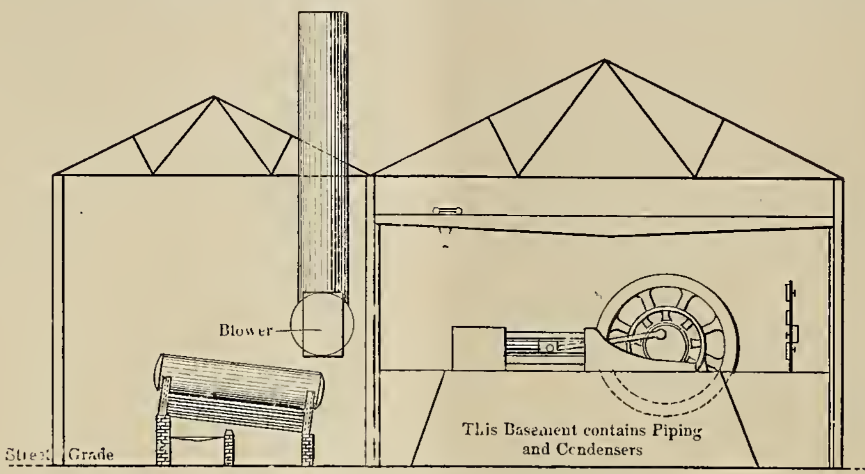
Graham, Va.—J. B. Greever may be addressed concerning construction of electric light plant.

THE MODERN POWER HOUSE.

By Richard McCulloch.

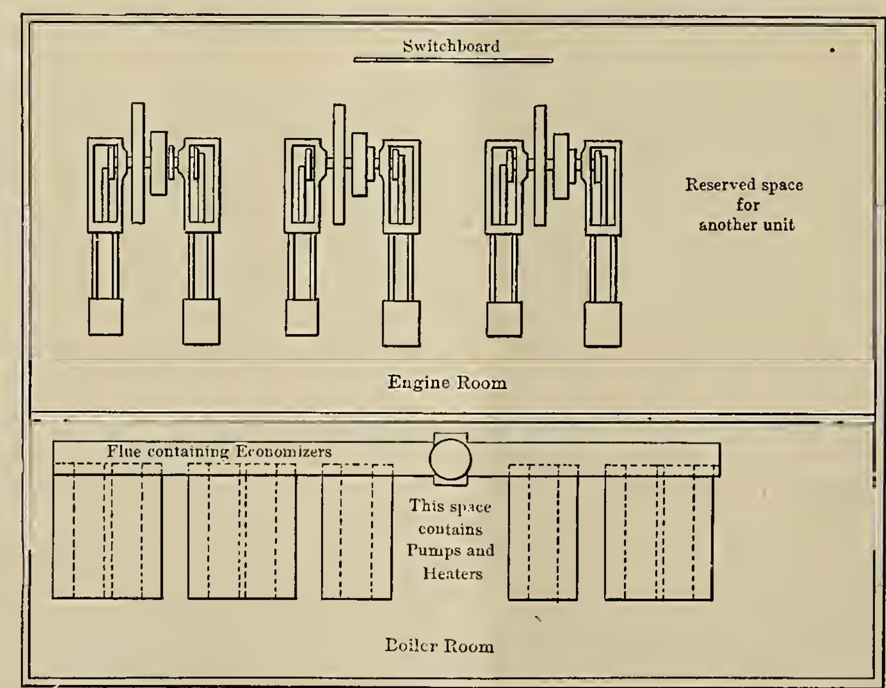
(Concluded.)

If readings be taken of the total output of the power house at stated intervals and then plotted, a load curve will be obtained similar to that shown in Figure 1. A study of this will show a very small load through the night from half-past one to half-past five, a sudden rise at this point to a maximum about seven a. m., a lower load



Sectional Elevation.

through the middle of the day, followed by another peak between six and seven at night, after which the load again suddenly drops. In order to accommodate the machinery to the varying load the number of dynamos in circuit must constantly be changed; and even then it is almost impossible to suit the power at all times to the load, the dynamos running much of the time either overloaded or under-loaded, which, of course, means a sacrifice of economy. In addition to the variation of load shown by the curve there is a momentary fluctuation, due to the starting and stopping of cars, the violence of which decreases with the number of cars in service. It is proposed to remedy this variation and operate the dynamos under a steady load by means of a storage battery plant connected in parallel with the line, charged from the dynamos during the period of light load, and discharged into the line on



Ground Plan

the heavy call for power. The operation of the plant under these conditions is indicated in Figure 1. Installations of this sort have been placed in several of the large electrical light plants, where they are operating with marked success, and there is no reason why they should not meet with the same degree of success in electric railway plants. By means of this auxiliary plant the proper number of dynamos are run throughout the entire day at their full capacity, and hence at their highest efficiency,

(Continued on page 184.)

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NEW YORK, MARCH 20, 1897.

CONTENTS.

THEFTS OF ELECTRICITY.

In the "Sun" of March 17 the following interesting little note may be found:

Hartford, Conn, March 16.—The House today passed a bill providing punishment for stealing electricity, with similar penalties to those provided for stealing gas.

We are very glad to hear that the public are beginning to appreciate the fact that electricity can be stolen, and not only that it can be stolen, but that such theft is punishable as described. We have heard recently of a German judiciary concluding while giving his opinion in a case where the plaintiff claimed that electricity was stolen that theft was impossible, or rather, that the theft of electricity was not a crime. The tangibility of power, even though it appears in a form which presents an unsubstantial side to the lay mind, ought to be recognized by all men desirous of being called modern minded and well educated. The most deplorable trait of some of the men high in judicial circles of life is the fact that they know too much about law and too little of the essential facts connected with some of the most important vocations in the world. If it be realized fully and comprehensively that the ownership and control of a great source of power far surpasses in value the proprietorship of a gold mine, a full realization of the value of power and the fact that it can be in part surreptitiously removed and that, to take it without permission, is equivalent to theft from the coal pile or money stolen from the cash drawer, then perhaps all States in the Union will pass a law imposing penalties upon those who steal power, even though it be electrical power.

THE HORSELESS CARRIAGE IN ENGLAND.

Attention has frequently been called to the advances made in the design and construction of horseless carriages. In England this matter is being very seriously considered because of certain characteristics which make their use a most desirable feature. That to which we refer is the road-beds and paving found in active centres, their suburbs, and frequently the great main roads leading from town to town. When the Romans took possession of the British Isles in earlier days they left landmarks behind, the most noticeable of which are the magnificent roads to which we refer. There is, therefore, every reason to suppose that the English cannot get these horseless carriages or possibly horseless drays fast enough. Parliament has but recently amended a law which removes the restrictions imposed upon vehicles driven by other than by animal power. This speed was limited to four miles an hour, and required the presence of a man with a flag to warn people to get out of the way. With this change in the limitations of speed, which are now fixed by law at twelve miles an hour, the use of horseless carriages and their application to numerous fields of work should progress most rapidly. In July, 1896, a test was made of at least a dozen kinds of carriages for the purpose of determining which could travel over fifty-four miles of the most hilly country in England and arrive in Brighton in the best condition and with the least delay. Peculiar to relate, an American carriage, which started and made excellent time, was unfortunately forgotten when the list of results was compiled. The carriages taking part comprise such styles known as dog-cart, tricycle, phaeton, landau and bath-chair. In the grand rush for precedence a carriage called the Bollee car won. Their speed is estimated at from sixteen to seventeen miles an hour. The others followed in due time. None of the cars mentioned in this test seem to have been driven by electricity, but we mention it because of a desire to show that a deep and public interest had been awakened such that the Mayor of Brighton was called upon to make remarks in connection with this event. The unusual facilities presented in England will probably make them a popular article of use and possibly as familiar a feature of the landscape as the omnipresent bicycle.

Albany, March 12, 1897.

Electrical Age Publishing Co.,

Dear Sirs: I have often felt like asking you to answer a question which I considered of some importance and which related to a Holtz static machine. I have at last summoned up enough courage to inquire.

Do you think it likely that a Holtz or any other static machine will ever be used for practical purposes; for the generation of power or light?

The simplicity of its construction and its cheapness have always impressed me.

Yours truly,
A. L. Delong.

(A.)—The static machine is not likely to be used for many years either for light or power.

The applications it may find in the various fields of work such as Geissler tube lighting or electro-therapeutics are about the only ones in sight at present.

Many have looked upon it as a possible source of power in the future, but not with any definiteness. For X ray work it is useful and may become more so in connection with vacuum tube lighting.

St. Louis, Mo.—City Clerk may give information concerning construction of an electric line from this city to St. Charles.

Olney, Ill.—M. D. Foster, Mayor, may give information concerning establishment of electric light plant.

the battery taking care of all eccentricities in the load, charging when the load is less than the capacity of the dynamos, and discharging when the load exceeds this. The steam plant may be shut down entirely during part of the night, leaving the battery to operate the road, and in case of a breakdown, the battery may be used to take care of the entire load for a short time. The battery is discharged through a booster dynamo, which is so designed that the compounding of the dynamos and the battery are the same. This arrangement is entirely automatic, so that no hand regulation is required. The efficiency of the battery operating under conditions of this kind will be guaranteed by the manufacturers to be greater than 75 per cent., and a maintenance of 6 per cent. per year on the first cost of the battery will be guaranteed. The great drawback to this system of operation is the large first cost of the battery, which is about $100 per horse-power capacity, figured on a two-hour discharge rate. A storage battery plant may also be used to increase the capacity of an existing power house and thus save the necessity of adding more machinery. There is another use to which a storage battery plant may be put which will, perhaps, appeal more strongly to the street railroad man. This is to install it as a substation to maintain the voltage at the ends of longfeeders, which are subject to fluctuating loads. In this case the batteries are charged from the distant power house and discharged into the trolley wire. The feeders from the power house to the storage batteries are figures only for the average load instead of the maximum load, as would be necessary in case the line is fed directly from the power house. The economy in this installation depends very largely upon the difference in cost between the feeders in the two cases. Besides the question of economy, however, the substation will give the better service if the voltage will not fall and rise with the fluctuations of the load.

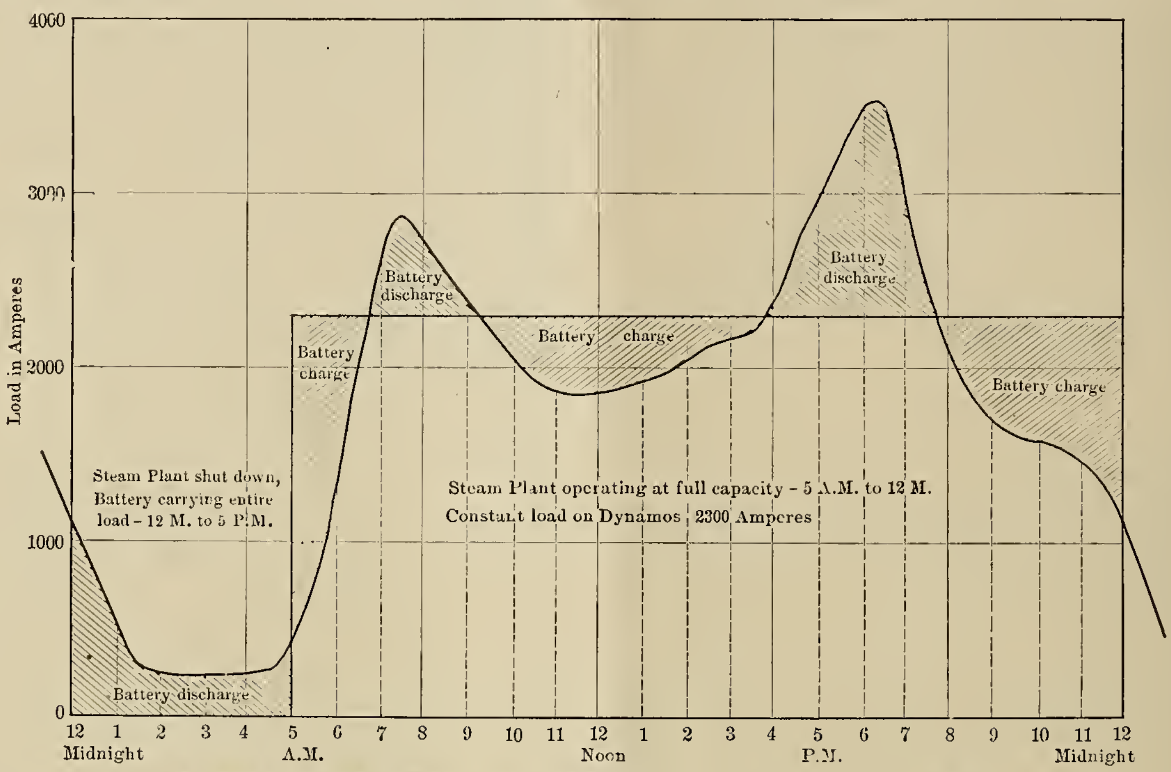
A number of power houses operating long lines are now equipped either with boosters or high voltage dynamos. Long lines usually have a booster constantly in circuit. This machine is automatic in its action and raises the voltage with every increase in the load. Some power houses operate a high voltage dynamo for use on sections which are subject to excessive loads. The feeder boards in this case are equipped with an extra buss-bar, so that any section may be thrown on the high voltage machine.

While each individual engineer has his own ideas concerning power house construction, and while each road building a power house may purchase different apparatus, there is one general design which has been followed in many of the plants recently installed. It has been adopted by so many different engineers and in so many different places that it might almost be called the modern power house. The general features of this design are shown in Figure 11. The engine room and boiler room are divided by a brick wall and under different roofs; both are brick buildings covered with an iron truss roof; the boiler room is set on the grade of the street and the engine room ten or twelve feet above this grade, the space below the engine room being utilized for the piping and condensers; the engine and boilers are set at right angles to the wall between them, with the engines next to the boiler room, so that the piping is made as short as possible and the condensation lessened; the switchboard and feeder-board are set on the opposite side of the room from the boiler room, so that the length of the dynamo cables is equalized as much as possible. The general features of this design may be summed up as follows: It is compact, to save real estate and buildings and to minimize the number of employees and the superintendence. Large units are used for the sake of economy and to save the number of working parts. The building is, as far as possible, fire-proof.

The electric part of the problem has been solved, temporarily at least, by the adoption of the multipolar, direct-coupled dynamo. The large, slow-speed engine has followed as a necessary consequence, and the general direction of improvement in power house construction seems to be toward the use of devices to prevent the waste of heat and to minimize the labor required.

There can be no more appropriate place to quote the proverb that cleanliness is next to godliness. An engine and dynamo room should be kept scrupulously clean. This is especially true in regard to the electrical devices, as a very small amount of grease and dirt in the wrong place will cause serious damage. Beyond the mere aesthetic consideration that cleanliness improves the looks of things, there is also the fact that a thorough cleaning amounts to a rigid inspection, and small leaks and defects are often discovered in this way which might otherwise pass unnoticed until they had become serious matters. It is to be regretted that this advice is not more generally followed, as there is more lost through dirty and greasy electrical devices, badly set valves, leaky steam joints, poor firing and careless supervision than ever will be gained through the use of compound condensing engines.

As a means of comparing different kinds of machinery, figures as to cost of operation have been collected from



STORAGE BATTERY OPERATING IN PARALLEL WITH STREET RAILWAY PLANT.

Battery capacity—700 H.P. at two hour discharge rate.

some of the large modern power houses; and their comparison reinforces what has just been stated, that less depends upon the refinements of the machinery than upon the condition in which the apparatus is kept and upon the supervision to which it is subjected. Among those having the lowest cost of operation was a power house equipped with direct-coupled generators, but operating single cylinder, non-condensing engines burning soft coal and using hand firing, while among those having the highest cost of operation are several power houses supplied with compound condensing engines and burning anthracite coal. The lowest results are about three-quarters of a cent per K. W. hour, some records running slightly below this, while the results from some of the large stations are as high as one and a quarter cent per K. W. hour. These figures include the cost of coal, water, supplies, repairs and all labor, but do not include anything for taxes, insurance, interest or depreciation. The cost of operation depends largely upon the cost of coal and upon the relation of the average lead to the total capacity of the power house; the higher this ratio, the less being the cost of operation.

The modern electric railway power house, although it has been developed entirely within the past ten years, represents the thought and the experience of many men. It has been developed carefully, detail by detail, until it is now a work both of reliability and efficiency. No one man and no one company can claim the credit for this achievement, but no class of men hold a stronger claim to recognition than the managers and owners of street railroad properties, who have ever been ready to encourage with their patronage each improvement, who have freely distributed the information gained by their experience, and who even in the most radical departures have ever acted with the courage of their convictions.

Chattanooga, Tenn.—C. W. Howard is organizing a company to establish a plant for supplying electric power to manufactories.

Harriman, Tenn.—The Mayor may be addressed concerning erection of electric light plant, for which bonds will probably be issued.

Greenup, Ky.—John L. Soward desires correspondence with contractors and manufacturers of electric light plants.

Raleigh, N. C.—The Raleigh Electric Light Co. is in the market for an electric light plant.

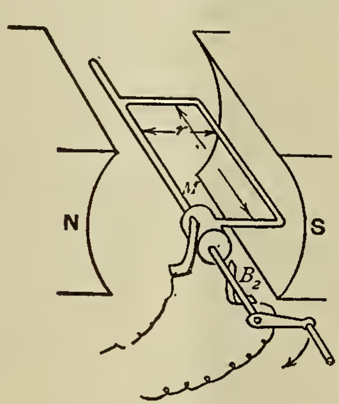
CONSTRUCTION OF THE DYNAMO.

LESSON LEAVES FOR THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

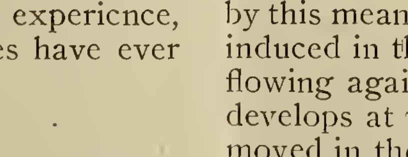
Motion of Magnet to a Coil.—The magnet may be moved toward a coil, forming a closed circuit, or the coil towards the magnet, as shown in the last sketch.

In either case the direction of the induced current is such that power is consumed. It is to be understood that no resistance is felt if the wire is open, but if closed the law of Lenz regarding the induced currents, their direction and reaction, becomes evident at once. When the coil is open an electromotive force is set up in it. The current does not flow, although the potential at each end would cause it to at once were the circuit closed. The movement of the coil brings it within the varying influence of the lines of force of the magnet. It passes when approaching the pole from a weaker to a denser field; on leaving, from a denser to a weaker. If the magnet were very big and strong, and the coil large, the labor of quickly moving it would be severe. The reaction set up between the magnet and coil, which causes work to be done, is entirely magnetic. The lines of force encircle the coil and are cut; a current is set up whose magnetic effect forces up to expend energy in continuing the motion.



Simple Dynamo.

The entire phenomenon is therefore simple enough from this standpoint—the attraction or repulsion of unlike or like poles. This final effect always occurs, the induced current having a direction which can be predetermined by this means. A coil approaching a north pole will have induced in that side of the coil nearest the pole a current flowing against the hands of a watch. A north polarity develops at that end and continues as long as the coil is moved in the neighborhood of the magnet.



Barlow's Wheel.

The current which produces this magnetic repulsion reverses in direction when the movement away from the magnet begins. The flow of an induced current is dependent upon the direction of motion as well as the polarity of the magnet.

The current which produces this magnetic repulsion reverses in direction when the movement away from the magnet begins. The flow of an induced current is dependent upon the direction of motion as well as the polarity of the magnet.

In the motion of a magnet to a coil the induced current opposes the further movement of the magnet.

Motion of Magnet from a Coil.—When a magnet is moved away from a coil, or lifted out of its embrace, the induced current flows in such a direction that resistance is felt. This is very noticeable with large magnets and coils; it can be indicated by means of a galvanometer with the very smallest. A retardation is felt, a sort of viscous resistance, which seems to be a dragging back of the magnet. It is again traced to Lenz's law for interpretation, and may be considered as directly due to a strong magnetic attraction which at once asserts itself. This attraction can only be due to unlike poles; it therefore follows that it is caused by a current of opposite direction to the first. The motion of a magnet from a coil induces a current which retards the further movement of the coil.

Simple Dynamo.—The principle just presented is made use of in the dynamo for the generation of heavy currents of electricity. Instead of a single coil moving back and forth in front of a magnet we have a succession of coils rotating on a shaft in a magnetic field. Each length of wire acts as an inductor, producing electromotive force. The pressure developed depends upon three factors:

Lines of Force,
Inductors,
Speed.

The rule is as follows: If a wire rotates in a magnetic field, cutting one hundred million lines of force per second, an electromotive force of one volt is developed.

With two wires twice as much would be created, or with one-half the field and four wires. This rule is applied to dynamos for the calculation of pressure.

The method employed is not confusing or complicated, as given below:

$$\text{volts} = \frac{\text{number of inductors} \times \text{lines of force} \times \text{revolutions per second}}{100{,}000{,}000}$$

Taking the case of a dynamo of this construction,

Inductors = 100
Lines of force = 4,000,000
Revolutions per second = 25

$$\text{Electromotive force} = \frac{100 \times 4{,}000{,}000 \times 25}{1000{,}000{,}000}$$

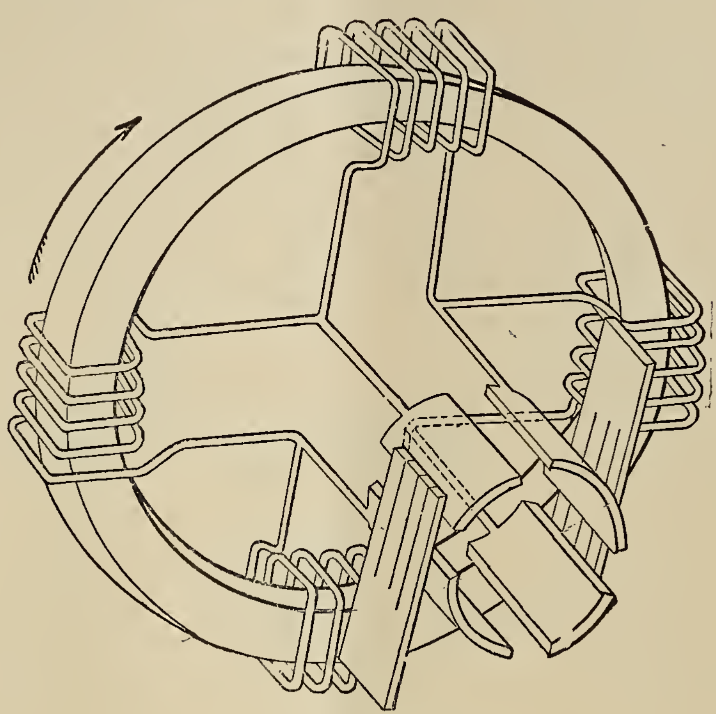
Electromotive force = 100 volts.

The number of turns on an armature differ according to its use. For high pressures in arc lighting there are many turns; for low pressures, such as plating, very few. Between these two classes of machines are those used for incandescent lighting. Many changes are noticeable to-day in the construction of dynamos. The two groups called

Bipolar or two-pole and
Multipolar or many poles

comprise all made with the exception of special types, some of which are built like Faraday's disk and others for alternating current work.

The Commutator.—The piece of mechanism which is used for the purpose of sending all the impulses out in one direction is called the commutator. It has been known in the past by another name, such as "rectifier" or "collector." As the armature rotates, the wires upon it individually generate a current; this is collected at the commutator bar connected to each one and received by the brush. One brush takes all positive impulses; the other all negative. As an inductor passes in front of one pole the current flows in an opposite direction to that it takes in passing in front of the other. This accounts for the use and necessity of a commutator.



Ring Armature.

Barlow's Wheel.—If Faraday's disk is taken and allowed to dip into a trough of mercury connected to one wire, the other going to the shaft, and a current be applied, the wheel will rotate and perform all the functions of a motor.

This wheel, which is simply an application of Oersted's principle, is the type of all modern motors.

(To be continued.)

Nanaimo, B. C., Feb. 29, 1896.

The Electrical Age Co.,

Dear Sirs:—As a subscriber I should like you to answer the following questions through correspondence column of the Age.

(1.) The number of wire to be wound on a Siemens' shuttle-wound (laminated) armature 1 by 1 3-8 in. with best efficiency (for 110 volt circuit). As a motor, about what horse power would it give out?

(2.) Safest current capacity of the above wire?

Yours truly,
Colin C. McKinzie.

(A.)—Wind the armature with a fine wire about No. 30 B. & S. gauge and see that the field is in series with armature when on 110 volts.

This wire will carry about one-fifth of an ampere safely.

When used on line at above pressure the horse power given out will be less than one-twentieth. The information given is not sufficient for the proper determination of the correct size of wire. Send on more dimensions, speed, cross-section of armature, etc.

Long Branch, N. J., March 10, 1897.

Mr. C. P. Williams, No. 39 Cortlandt Street, N. Y.

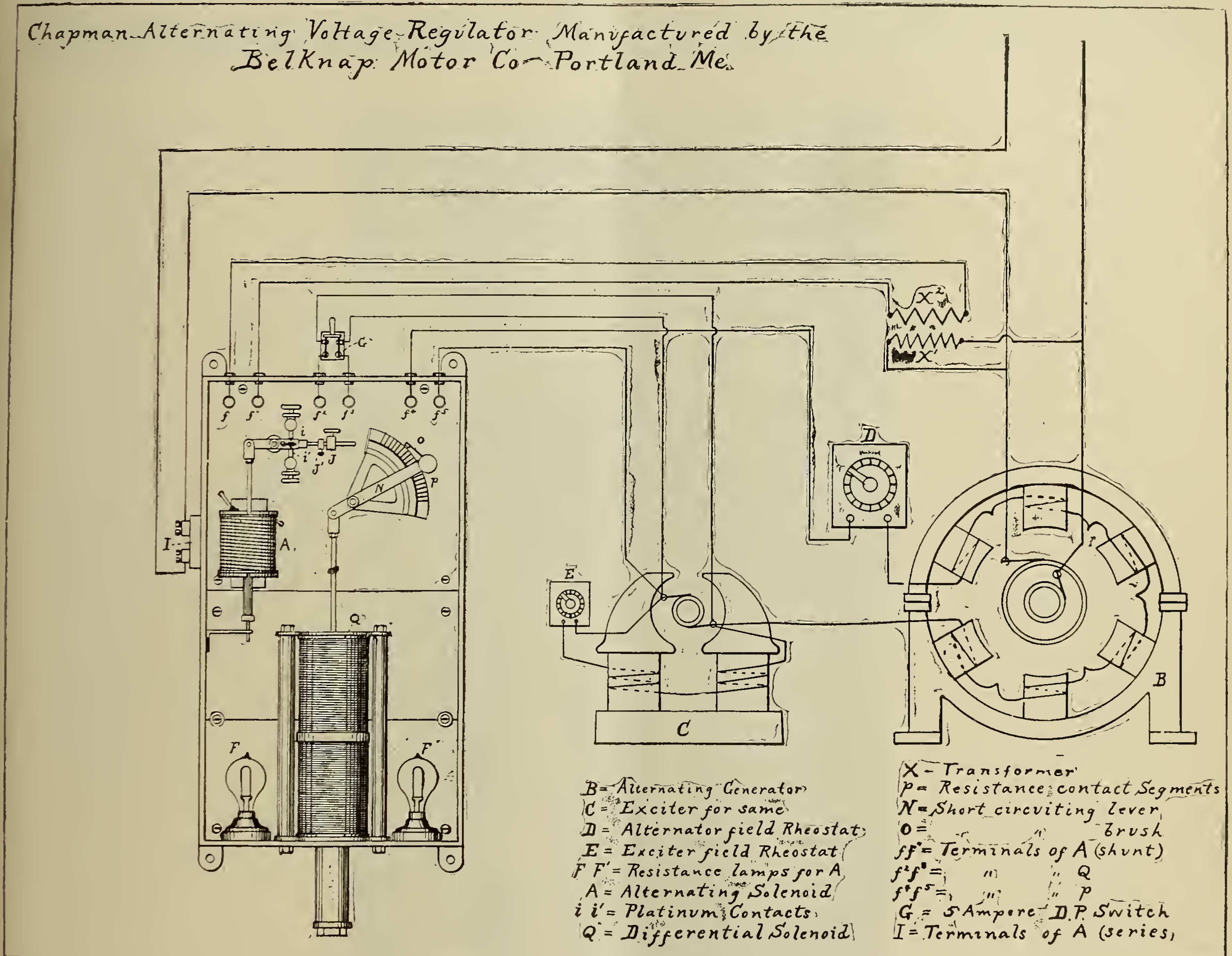
Dear Sir: I have been using the Alcatraz insulating paint for about three months and find it the best I have ever used and can cheerfully recommend it. Very truly,

(Signed) E. H. CLARK, E. E.

I enclose samples of moulding which have been through fire showing that, where the paint was used, the wood did not burn and the insulation of wire was preserved. Yours, E. H. C.

THE CHAPMAN VOLTAGE REGULATOR FOR ALTERNATING AND DIRECT CURRENTS.

The economical and efficient operation of a plant of incandescent electric lamps involves the nice adjustment of two opposing factors which enter as items of expense. As one item is increased in any given case the other is decreased, and vice versa. These two factors are on the one hand the life of the lamps, and on the other hand, the power consumed in operating the lamps. The life of a



Westfield, Mass.—A plant is to be erected for supplying electric power to manufacturing concerns.

Appleton, Minn.—Edwin Pickthorn and Albert S. Williams have been granted a franchise to erect and run an electric light plant.

Marshalltown, Ia.—An electric car line is being built from Mason City to Clear Lake.

Cambridge, Mass.—The West End Street Railway Co. will erect a new $400,000 power house in East Cambridge.

De Funiak, Fla.—The Mayor may be addressed concerning establishment of electric light plant.

Burlington, Vt.—The Grand Isle Electric road will be built.

South Paris, Me.—The Oxford Central Electric Railroad will probably be built.

Portland, Me.—The Yarmouth Electric Railroad will build power house at Falmouth Foreside.

Watervliet, N. Y.—City Clerk may be addressed concerning establishment of electric light plant.

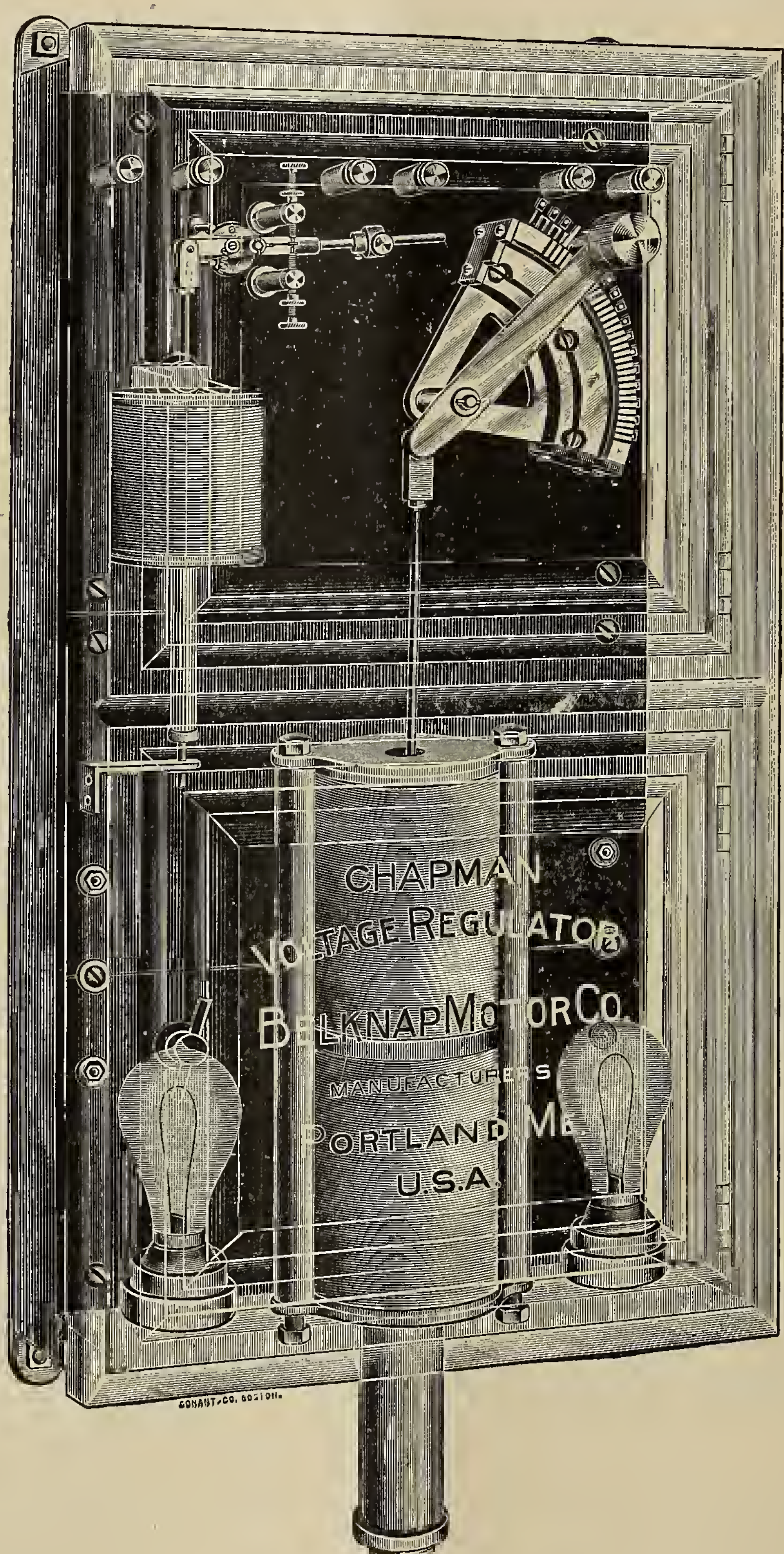
lamp is favored by making it a great watt consumer. A lamp using four watts per candle-power has a much longer life, other things being equal, than a 2 1-2 watt lamp, but the power used makes it expensive to operate. And on the other hand the 2 1-2 watt lamp when subjected to fluctuations of voltage becomes expensive in the item of lamp renewals. Close regulation is important for any lamp, but when the low watt lamp is used it becomes an all-important factor in economy, and it is not infrequent to see in a lighting station one or more attendants constantly engaged watching the volt-meter and operating a hand rheostat as the changes of load or speed demand.

The high watt lamp is necessarily expensive in the item of power, and the low watt lamp is also expensive in the item of lamp renewals when the regulation is poor. But the low watt lamp combined with perfect regulation is the perfection of economy with incandescent electric lighting. Every intelligent station manager fully appreciates this fact, and a good voltage regulator is the urgent demand of the times, and this demand is fully met in the new Chapman voltage regulator, which the Belknap Motor

Co. are now putting on the market. A large number of these have been put out and are in practical operation, and have proved to be all that could be desired. The regulator is a magnetic device and acts very promptly, being only limited in quickness of action by the ability of the generator it may be regulated to respond to change on a field rheostat. The device is essentially a field rheostat whose operation is entirely automatic. The moving of the rheostat arm is accomplished by the action of a working solenoid, and the actions of the working solenoid are determined by those of an auxiliary solenoid which operates a set of contacts that control the admission of current to the sections of the working solenoid. The working solenoid is differentially wound and is composed of four distinct coils, two of which have a small continuous current flowing through them, in mechanical opposition to each other; the contacts close the circuit of one or the other of remaining coils and so neutralize the action of one of the continuously acting coils.

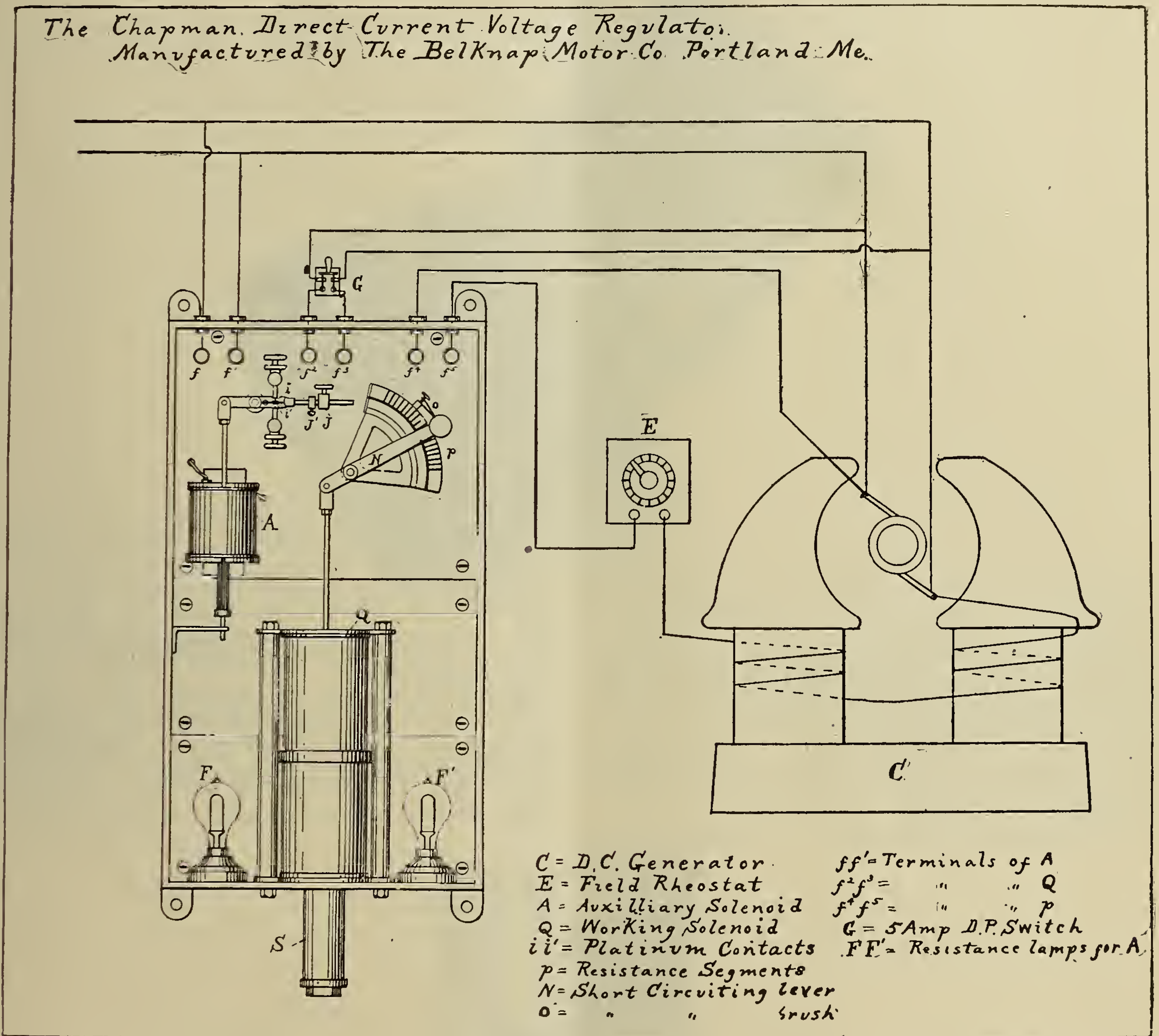
This manner of connecting secures a rise of magnetism in the iron core of the solenoid whenever a break occurs at the contacts, and so avoids any injurious sparking at the contacts that would naturally occur by the magnetic discharge of the core. The arrangement completely neutralizes the induction discharge, and no induction spark can occur. All of the usual objection to contact points is therefore entirely removed, and we may set them very close and secure the most sensitive adjustment of the apparatus.

The entire work of the auxiliary solenoid is to move a lever arm with contact attached through a short space of say one-thirty-second inch, and a very slight change of voltage is sufficient to do this. It is often desirable to have the voltage at the generating station rise a little with the load so that it becomes greater than the voltage of the distributing centre where it remains constant with changes of load. This result is aimed at in the compound winding of the generators, but, in most cases, is far from securing the result desired on account of the changes of speed, which no compounding of the generator can compensate for. The compounding of our auxiliary solenoid, however, secures the desired result under all conditions of speed or load, and a plain shunt-wound generator becomes just as effective as a compound-wound generator. And the use of our regulator enables the old style alternating-current generators having no compound coils to do just as good work as the more modern apparatus. Many machines that have been discarded as out of date will again become valuable and equal to the best.



And the same is also true of direct-current generators. There are many old generators of the shunt-wound type that will become just as useful as the more modern-built machines, and even more so, by the attachment of the voltage regulator to them.

As to the energy consumed in our regulator, it is so small as to be negligible. The operation of the large working solenoid only required the use of 60 or 70 watts of energy, and the rheostatic part of the device is concerned only with the current in the shunt winding of the generator which, as is well known, is only a very small percentage of the output of the machine. So that the regulator may be operated on a machine of 150 k. w. with an extra expenditure of energy not exceeding 1-4 horse-power.



Papers to be Read at the Convention of the N. E. L. A.—The following list of papers will be read at the Convention, and the names of the authors are a guarantee that the papers to be read will be of a high order of merit. Some of the manuscript is already in the hands of the secretary, and, depending upon the assurance of the authors that their manuscript will be forwarded at an early date, it is expected that printed copies of each of the papers will be furnished members a reasonable time before the date of the Convention:

Bean, W. Worth, St. Joseph & Fort Benton Ry. & Lighting Co. "Municipal Lighting."

Cahoon, J. B., Elmira Municipal Improvement Co. "Standardizing Prices for Incandescent Light and Power."

Edgar, C. L., Boston Edison Co. "Correct Method for Charging for Product."

Jewel, W. S., Toledo Traction Co. "Cost of Delivery of Current from Station to Customer."

Martin, T. C., Editor Eletcrical Engineer. "The Daylight Work of Central Stations."

Stilwell, L. B., Cataract Construction Co. "Electrical Development at Niagara."

Thomson, Prof. Elihu, Lynn, Mass. "Recent Progress in Arc Lighting."

White, J. G., White-Crosby Co. "The Niagara Power Transmission Line."

Wilson, Professor, Professor of Electrical Engineering at McGill University, Montreal; Chas. A. Carus, Member Institute Electrical Engineers, New York and London. "The Induction Factor, a New Basis of Dynamo Calculation and Classification."

Wright, Arthur, President Municipal Electrical Association, England. "The Profitable Extension of Central Stations."

The Convention is to be held at Niagara Falls this June and promises to be attended as enthusiastically as on past occasions.

POSSIBLE CONTRACTS.

Norway, Me.—An electric road will probably be built to Waterford and Stoneham.

Cochran, Ga.—Town Council may be addressed concerning erection of electric light plant.

Fitzgerald, Ga.—The Mayor may be addressed concerning establishment of electric light plant.

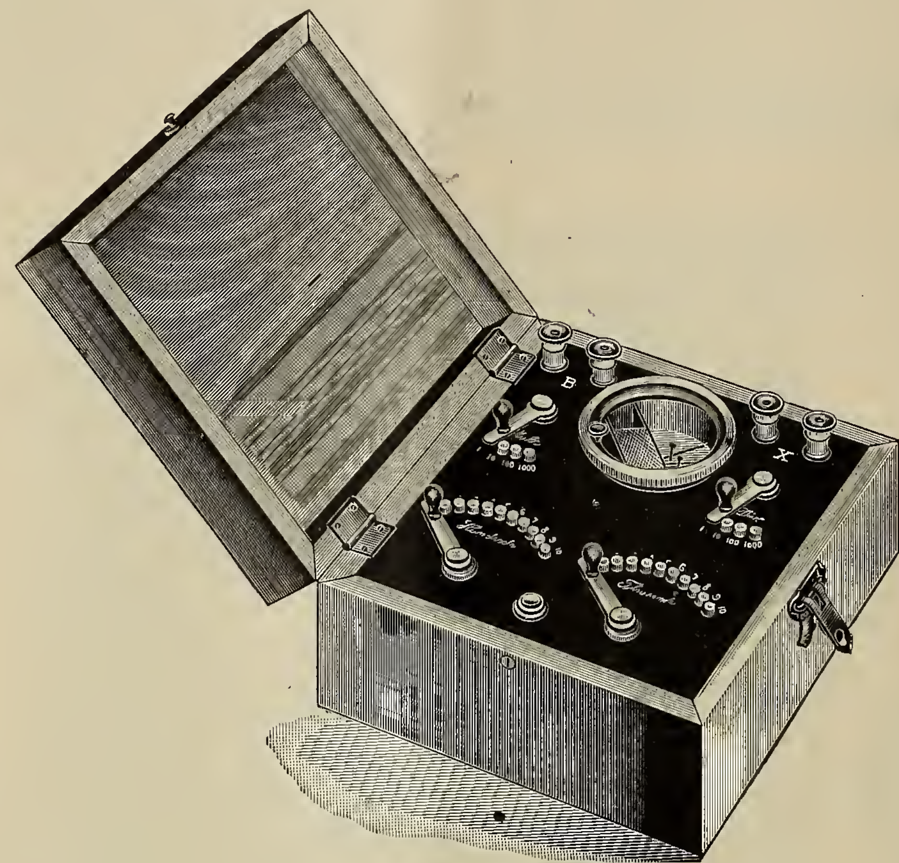
Jellico, Tenn.—An electric light plant may be established.

Baraboo, Wis.—City Clerk may be addressed concerning establishment of $20,000 electric light plant.

Waterloo, Ohio.—An electric light plant is to be established.

A NEW WHEATSTONE BRIDGE.

A decided innovation has appeared upon the market in the shape of a new Wheatstone bridge. In this device the method of plugging resistances is entirely dispensed with. Instead there are four arms similar to those used in any rheostat sliding upon brass contact points marked respectively according to their resistance.



Wheatstone Bridge.

The old practice of plugging and unplugging was the cause of many inaccuracies appearing in the test. The oxide on the surfaces in contact and their possible looseness supplied undesirable elements of doubt.

With the resistances arranged like the pegs of an ordinary rheostat and an arm pressing tightly upon them, all of these chances disappear.

It is merely necessary to move the arm to the resistance required, whether it be in the proportional arms or the main resistances, to quickly and effectively bring the same into play.

With so great a convenience, and such good contact, the best possible results are attainable.

The users of testing apparatus will greatly appreciate this most useful form of the portable bridge, and cannot fail to realize the great advantage its use implies—no plugs to lose, but a substantial and convenient outfit of the latest design.

Many testimonials of a high order have been received from leading firms having occasion to use this bridge. Below a few are mentioned: C. E. Nicholas, Electrical Contractor, Columbus, O.; The Western Light and Power Co., Chicago, Ill.; F. P. Jones Co., Buffalo, N. Y.; Osburn Electric Supply Co., Chicago, Ill.; McTell Elec. Co., Chicago, Ill.

Mr. M. A. Knapp manufactures these goods in Chicago. Mr. J. P. Williams, of No. 39 Cortlandt street, is general agent for the East. We congratulate him upon his valuable acquisition, and predict every success for him.

Hand Milling Machine.

HAND MILLING MACHINE.

The machine shown in the engraving is the No. 3 Hand Milling Machine made by the Garvin Machine Co., Spring and Varick streets, N. Y.

This machine has been essentially improved and is well adapted for light, quick cuts as required in manufacturing

(Continued on Page 191.)

THE "SURE GRIP."

It is gratifying to realize that a simple and efficient lamp cord adjuster has been placed upon the market by Chas. Schuetz, 211-213 Market street, Newark, N. J.

This "Easy" adjuster possesses many valuable features which are sufficient to invite the attention of all practical men. The more pull that is exerted upon it, the tighter it grips. Slipping is therefore impossible, and the loop of cord can be easily pulled through when the lamp is to be raised or lowered. This adjuster is made of three wooden pieces, two of which are U-shaped and similar; the other is held between the U ends respectively of the other two by means of steel pins. These pins can be readily removed; they cannot fall out because they are split, and the round end of each acts like a spring to keep them in place. The cord is not frayed or injured by this adjuster because, when a strain is put upon it, two pairs of surfaces grip. The bottom of the U-shaped piece and the round end face of the middle piece constitute one pair, and two similar surfaces the other. Hard, tough, well-seasoned wood, carefully prepared, is used for the essential parts of these "Sure Grip" adjusters. They are the superior in strength of any on the market.

The Sure Grip.

No fraying, no tearing, no breaks; perfect safety and satisfaction. Write for prices to Chas. Schuetz, 211-213 Mulberry street, Newark, N. J.

(Continued from Page 190.)

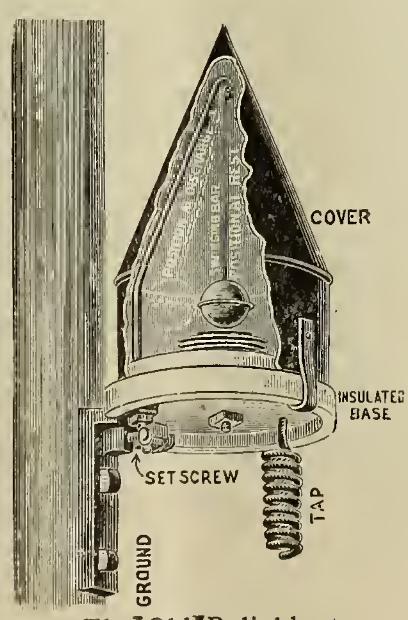
the small parts of type-setting machines, typewriters, hardware articles, electric fixtures, etc. The spindle, arm, and upper portion of the base are similar to our column machines, while the table offers some advantages in the position of working. The knee and slide are moved by long levers with adjustable stops. The slide has screw adjustment in line with the spindle. The knee is balanced in all positions, which gives an easy sensitive motion and facilitates working. The levers are adjustable in position. The spindle and bearings are our standard form.

This machine, as well as a large line of machine tools and special electrical and bicycle machinery, is fully described in a new catalogue just issued in English, French and German.

"THE OLD RELIABLE."

Lightning arresters that don't arrest are as numerous as swallows in the spring. Many of them represent an excellent principle, but they fail in construction; others are just the opposite. Substantially built, the chances of them ever operating are few and far between. When the fortunate combination occurs, of a reliable arrester and solid construction, that is the lightning arrester that is worth buying—particularly if its simplicity is its greatest feature.

A lightning arrester, as the reader probably knows, is simply put in circuit with the line, the current ordinarily flows through it. If lightning strikes this line it will



The Old Reliable.

enter the station and destroy the dynamos unless intercepted. The best way of intercepting it is to lead it to the earth. All lightning arresters try to do this, likewise attempting to destroy the arc that is apt to continue after the static discharge has passed. The "old reliable" has a swinging ball, which only swings when a discharge occurs—when the line is struck. The ball is grounded; it thus allows any spark from the line to pass into it and to the earth. The swing the ball has breaks any arc

that may attempt to follow. Mr. A. Blackburn is the enterprising proprietor, and James D. McIntosh, the able sales agent; No. 26 Cortlandt street, N. Y .

Hawkinsville, Ga.—S. A. Way, mayor, may be addressed concerning erection of electric light plant, for which bids have been postponed indefinitely.

Knowlton, Que.—The electric light company propose putting in a new electric plant in the spring.

Mooresville, N. C.—George C. Goodman desires estimates on electric light plant for city of 1,000 inhabitants.

Vicksburg, Miss.—J. J. Hirsch may be addressed concerning construction of an electric power plant by proposed railway company.

St. Louis, Mo.—Fred E. Allen, Eugene Benoist and Breckenridge Jones contemplate the erection of an electric light plant.

Huntsville, Ala.—The Huntsville and Monte Sano Improvement Co. has obtained privilege to increase its capital stock to $1,000,000, and to construct gas and electric plants, etc.

Clarksville, Tenn. — The Clarksville Electric Light Co.'s plant has been purchased by Thomas Bourne, who will operate same.

Sweetwater, Tenn.—The city clerk may be addressed for information concerning the establishment of an electric light plant.

Randolph, Vt.—Steps are being taken to establish an electric light plant.

Suffield, Mass.—The Electric Light Co. is preparing to establish an electric light plant.

Neola, Iowa.—City Clerk may be addressed concerning proposed establishment of electric light plant at a cost of about $3,500.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued December 8th, 1896.

572,512. Process of Manufacturing Phosphates of Alkalies. Heinrich Albert, Biebrich, Germany. Filed January 28, 1896.

572,525. Electric Elevator. John P. Casey, Bloomsburg, Pa. Filed August 23, 1894.

572,539. Electric Arc Lamp. Charles Goodyear, Jr., New York, N. Y. Filed October 16, 1895.

572,561. Elevator Signal Apparatus. Stacy B. Opdyke, Jr., Philadelphia, Pa. Filed April 24, 1894.

572,562. Elevator Signal Mechanism. Stacy B. Opdyke, Jr., Philadelphia, Pa. Filed October 8, 1894.

572,563. Elevator Signal Apparatus. Stacy B. Opdyke, Jr., Philadelphia, Pa. Filed December 18, 1894.

572,607. Electric Signal Apparatus. George Knowles, Milwaukee, Wis. Filed July 19, 1895.

572,609. Telegraph System. Benjamin F. Merritt, Orange, N. J., and John M. Joy, New York, N. Y. Filed June 27, 1896.

572,627. System of Automatic Electric Regulation. William L. Bliss, Brooklyn, N. Y. Filed May 6, 1896.

572,636. Electric Furnace. James E. Hewes, Philadelphia, Pa. Filed September 8, 1896.

572,639. Telegraphy. Isidor Kitsee, Philadelphia, Pa. Filed February 20, 1896.

572,706. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa. Filed November 4, 1886.

572,748. Electric Switchboard. Edmond A. Fordyce, Chicago, Ill. Filed November 4, 1893.

572,754. Automatic Circuit-Closing Device for Galvanic Batteries. John D. Holmes and Webster L. Heath, St. Louis, Mo. Filed October 1, 1896.

572,760. Printing Telegraph. Leo Kamm, London, England. Filed December 30, 1895.

572,775. Telephonic Apparatus. Carl J. Schwarze, Adrian, Mich. Filed June 30, 1896.

572,777. Electric Arc Lamp. Thomas Spencer and Christian Toerring, Jr., Philadelphia, Pa. Filed May 6, 1896.

572,778. Pole Socket. John H. Stevenson, Ann Arbor, Mich. Filed April 30, 1896.

572,801. Telephone Exchange. Myron F. Hill, Cambridge, Mass. Filed July 16, 1895.

572,805. Electric Lamp. Louis A. Jackson, New York, N. Y. Filed July 25, 1896.

572,840. Telephone System. Alfred F. Swan, Bayonne, N. J. Filed July 11, 1895.

572,903. Regulating Electric Motors. Harry W. Leonard, New York, N. Y. Filed June 24, 1892.

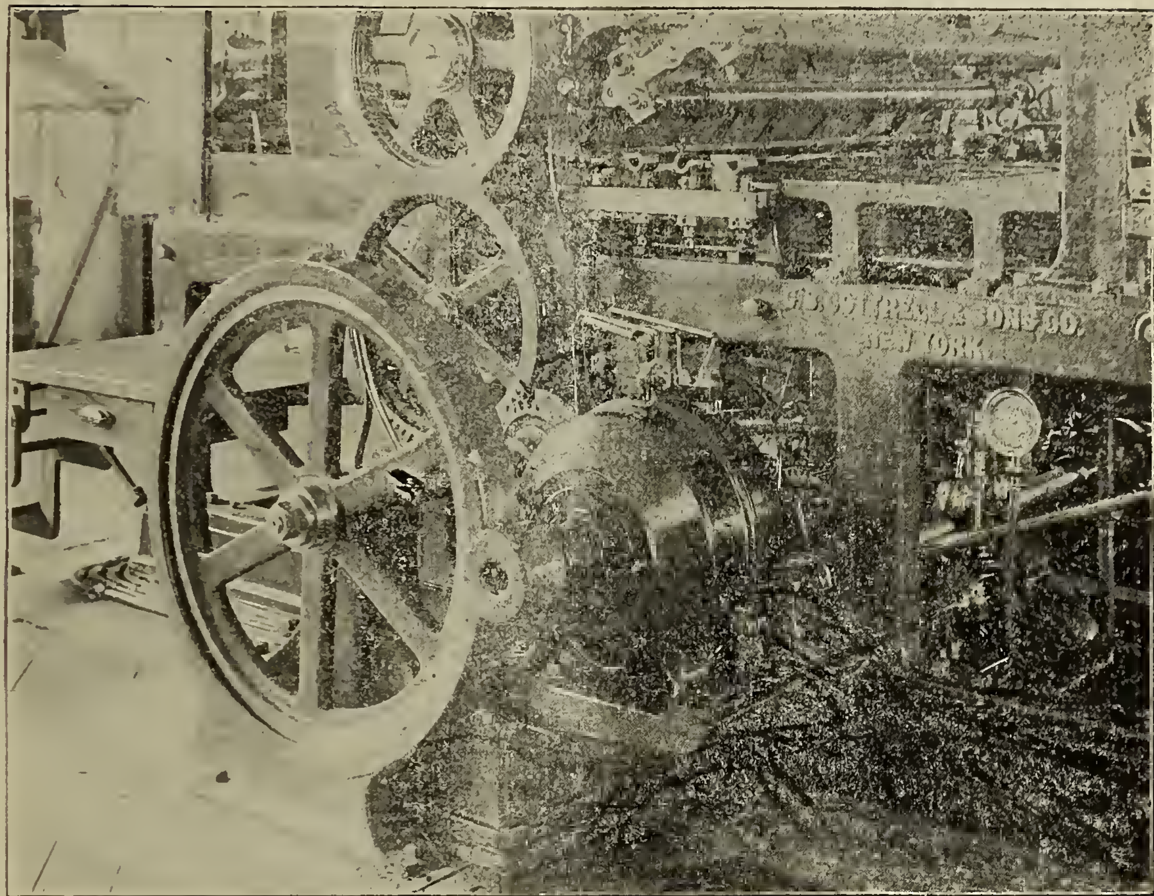
572,923. Automatic Circuit Closer. Edwin C. Williams, Clarksville, Tenn. Filed May 9, 1896.

572,933. Trolley for Electric Railways. Henry A. Seymour, Washington, D. C. Filed June 15, 1896.

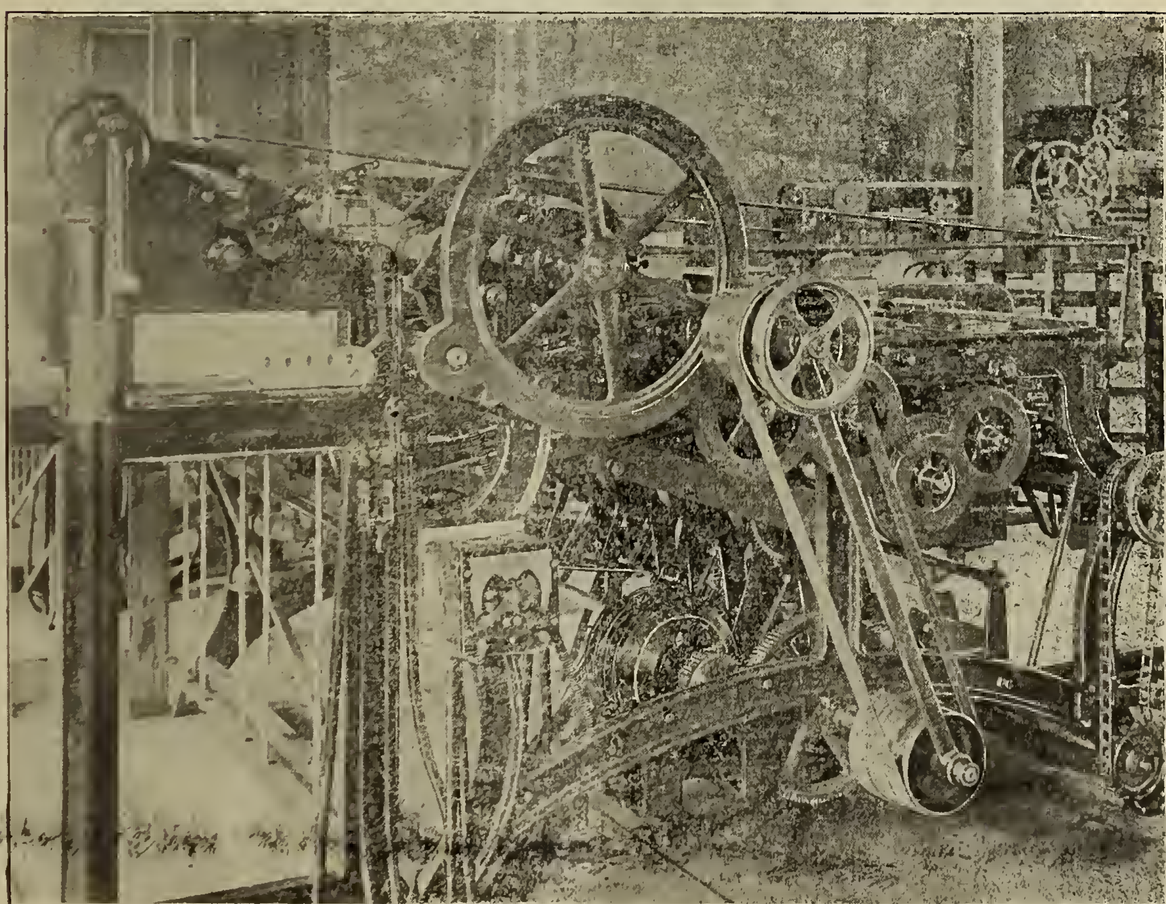
572,940. Support for Trolley Wheels. Christian F. L. Orth, New York, N. Y. Filed April 16, 1896.

The Electrical Age.

VOL. XIX., No. 13. NEW YORK, MARCH 27, 1897. WHOLE No. 515



Lundell Geared Motor Outfit.



Folding Machine Operated by a Lundell Motor.

BELTLESS MACHINERY.

The use of motors in shops has of late grown to be a very noticeable feature of their equipment. Both printing establishments and book binderies are rapidly accustoming themselves to this innovation, and particularly in directly applying the motor to whatever machinery it is supposed to control. This method threatens the complete abolition of the belt, thus removing the hangers, counter-shafting, oil spatter, etc., which are the usual accompaniments of belting machinery.

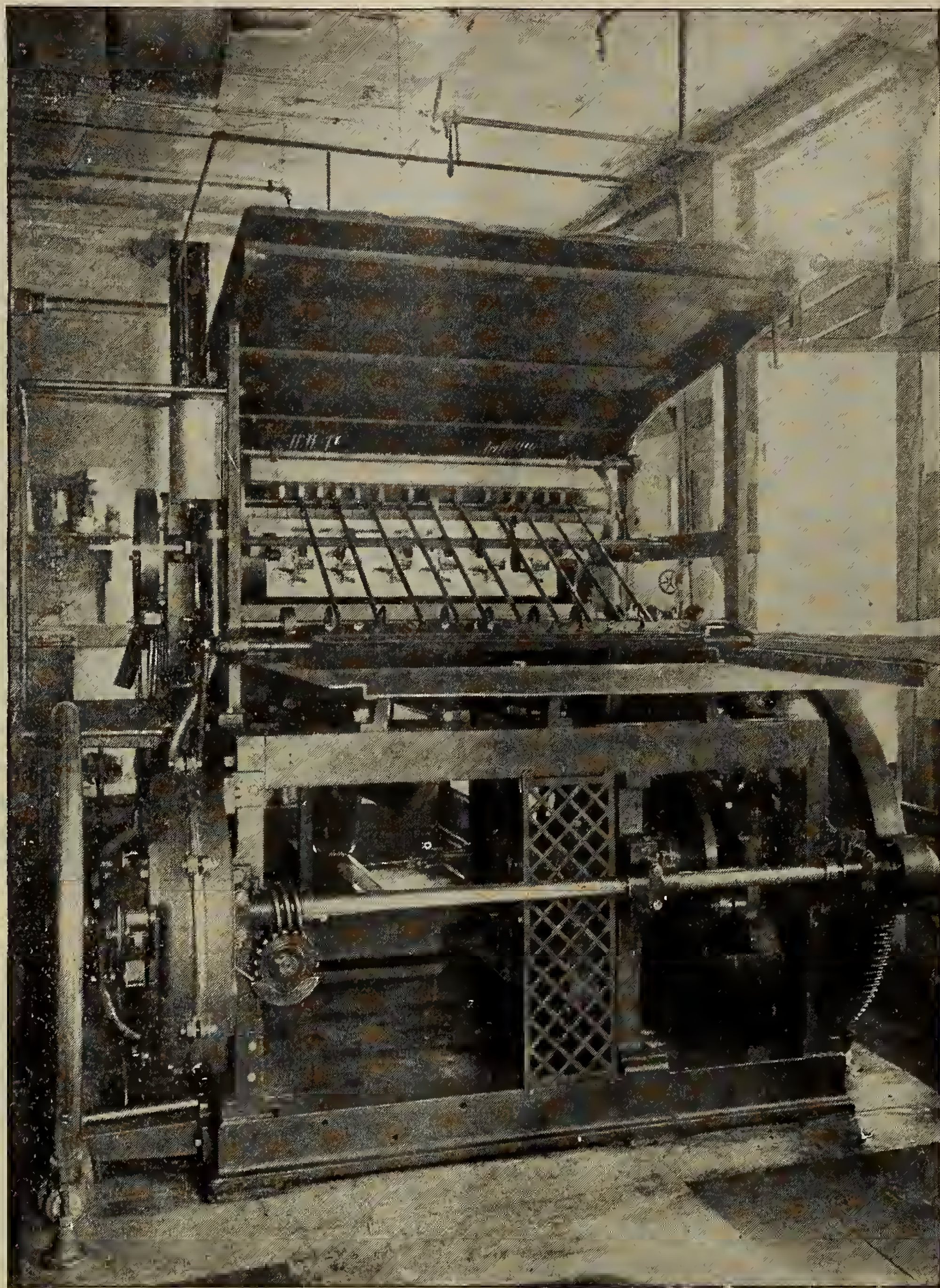
The safety, cleanliness and economy of a direct-connected motor equipment can be well appreciated by the shop foreman and his men.

Not only will shafting get out of line, but power is lost from friction, which in some cases has been known to exceed 50 per cent. of that applied.

Prof. J. J. Flather gives some tests which substantiate the above estimate.

Union Iron Works,	23	per cent. lost.
Ferracute Mach. Co.,	31	" "
Bridgeport Forge Co.,	50	" "

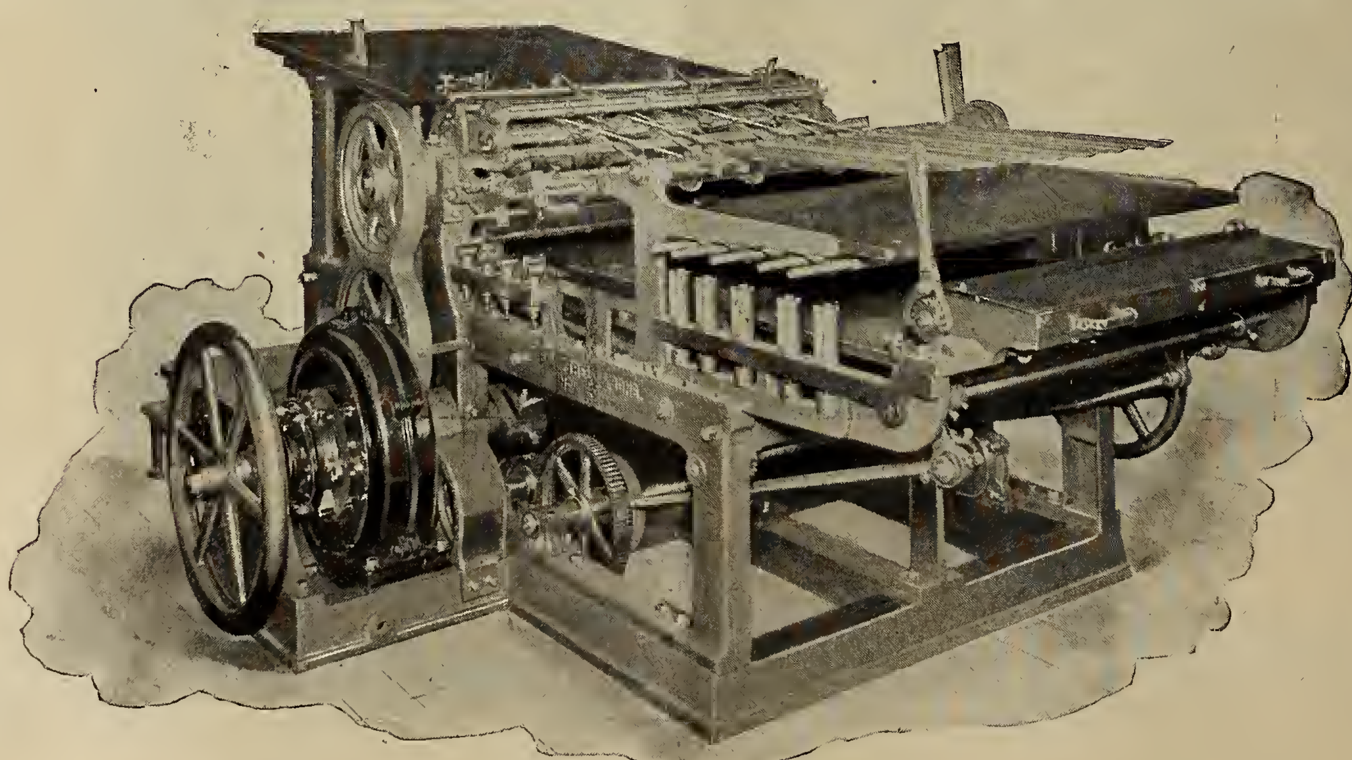
Other figures could be given, for instance, of the Baldwin Locomotive Works, where 80 per cent. of 2500 horse



Press with Lundell Motor Direct-Connected.

power is wasted and dissipated in shafting and belting.

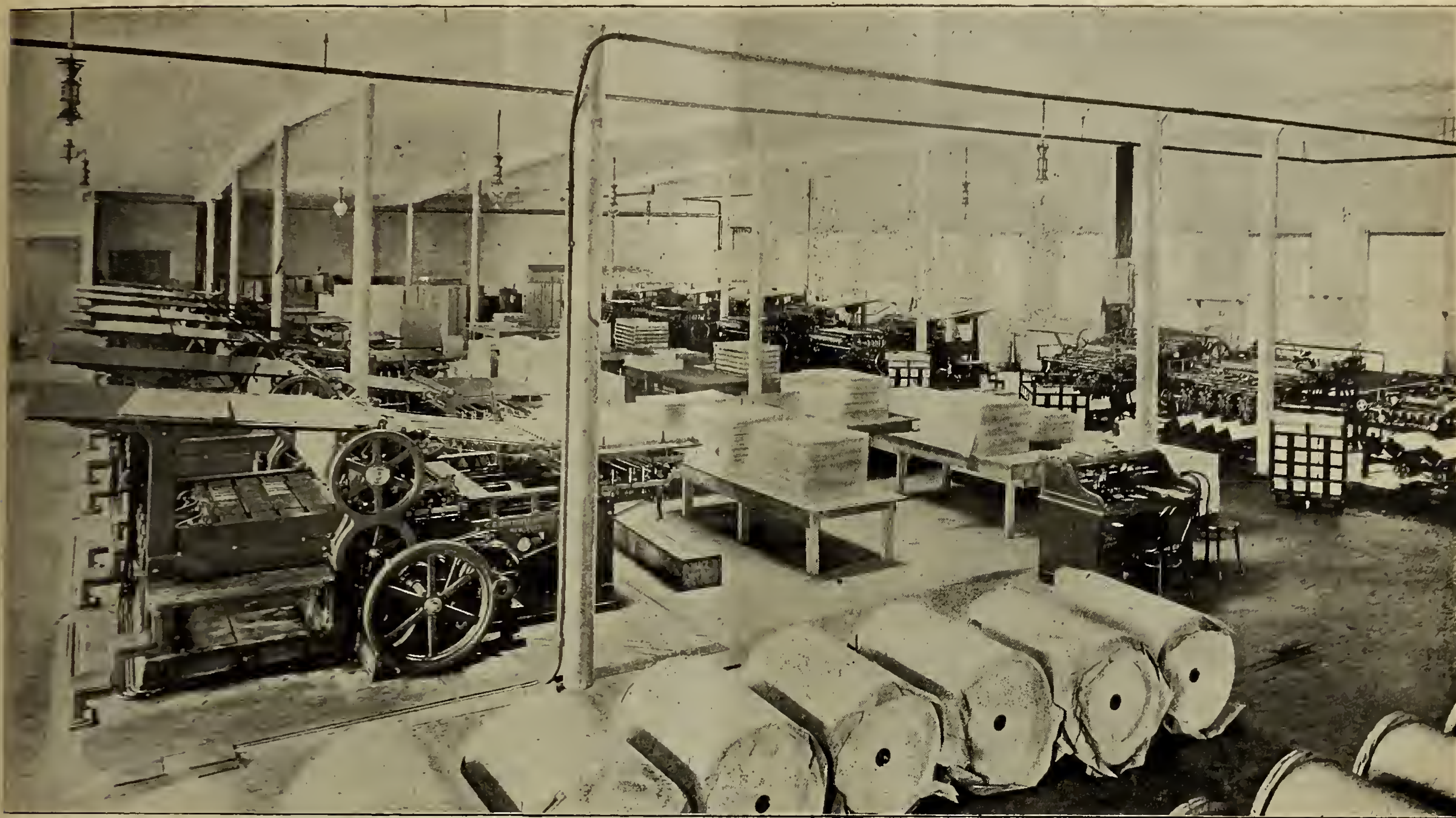
Mr. J. T. Henthorn notes in a paper read before the



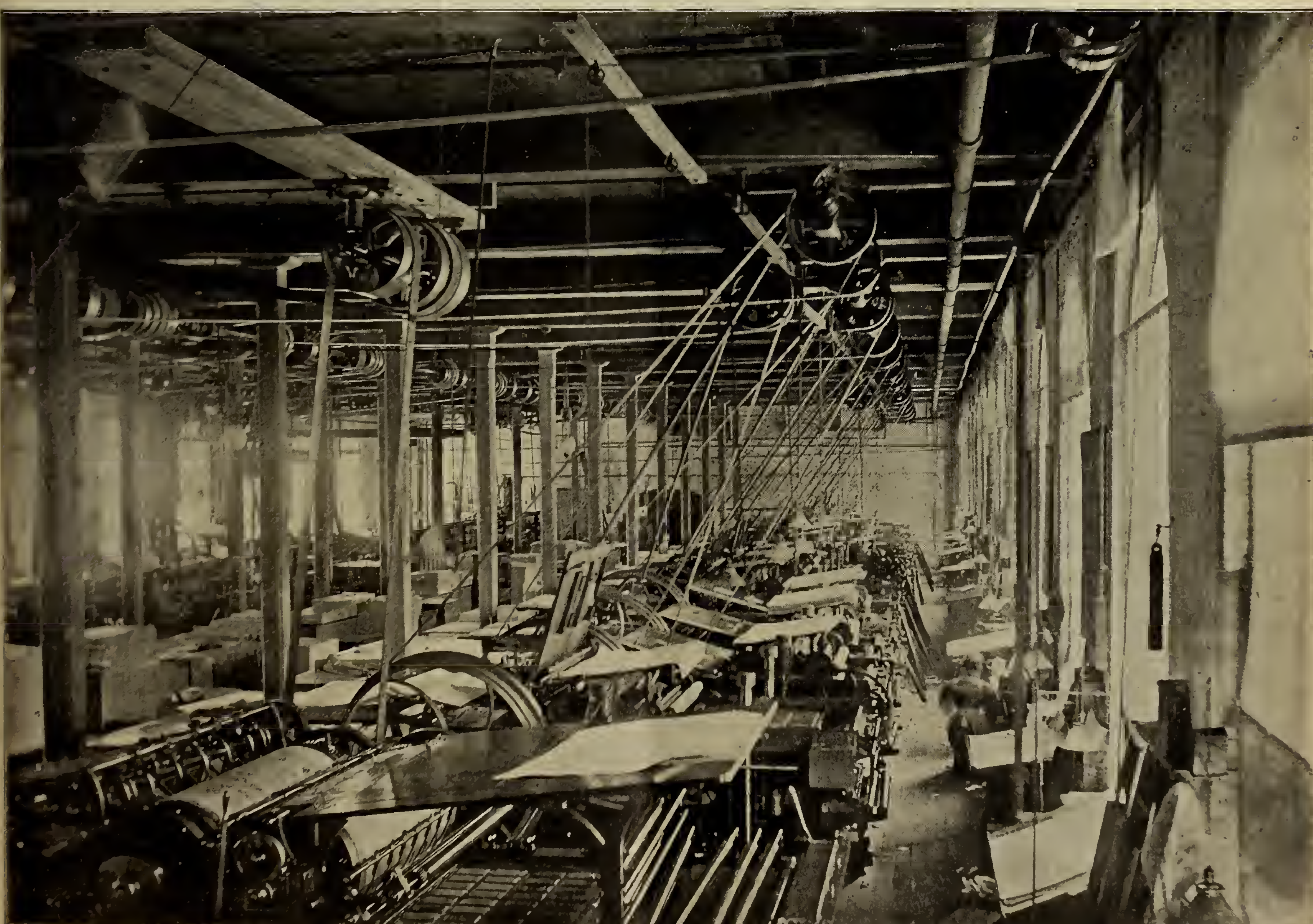
Complete Press Equipment.

American Society of Mechanical Engineers that out of 55 cases, the average was 25.9 per cent. Records have been taken of tests which showed a loss of 93 per cent. during transmission. There is, therefore, not only the appearance of a shop to be considered or the absence of dangerous belts, but the actual saving in dollars and cents effected by the use of motors.

The direct application of a motor to machines is doubly



Modern Press Room—Each Press Operated by a Lundell Motor.



Belt Driven Press Room.

welcome to the printer, because considerable power is saved from waste while getting ready to print.

The Lundell motor, manufactured by the Interior Conduit and Insulation Co., of No. 527 Thirty-fourth street, is peculiarly adapted to work of this nature, as evidenced by the illustrations attached. The independence of each piece of machinery makes it impossible for the entire shop to be delayed by a broken belt or equivalent trouble.

A modern pressroom equipped with Lundell motors would present a perfect elysium to the progressive printer. The excellent qualities of the electric motor, its great and inherent ability to take care of itself and its features of regulation are never forgotten by those that break the ice of prejudice and try one.

The power consumed as electrical energy is registered in the meter and will act as a reliable indicator of the amount absorbed during hours of labor.

Without heat, odors or the dangers of fire, but with compact machinery and lots of air, there is nothing more desirable than a direct-connected shop equipment.

The application of Lundell motors may be effected by gears or direct connection.

In the latter case the speed of the motor is within the compass of the driven apparatus. Slow speed Lundell motors are therefore in great demand for this purpose, a new line of them having recently been placed upon the market. The simplicity of construction, lack of friction and noiselessness are great points in their favor.

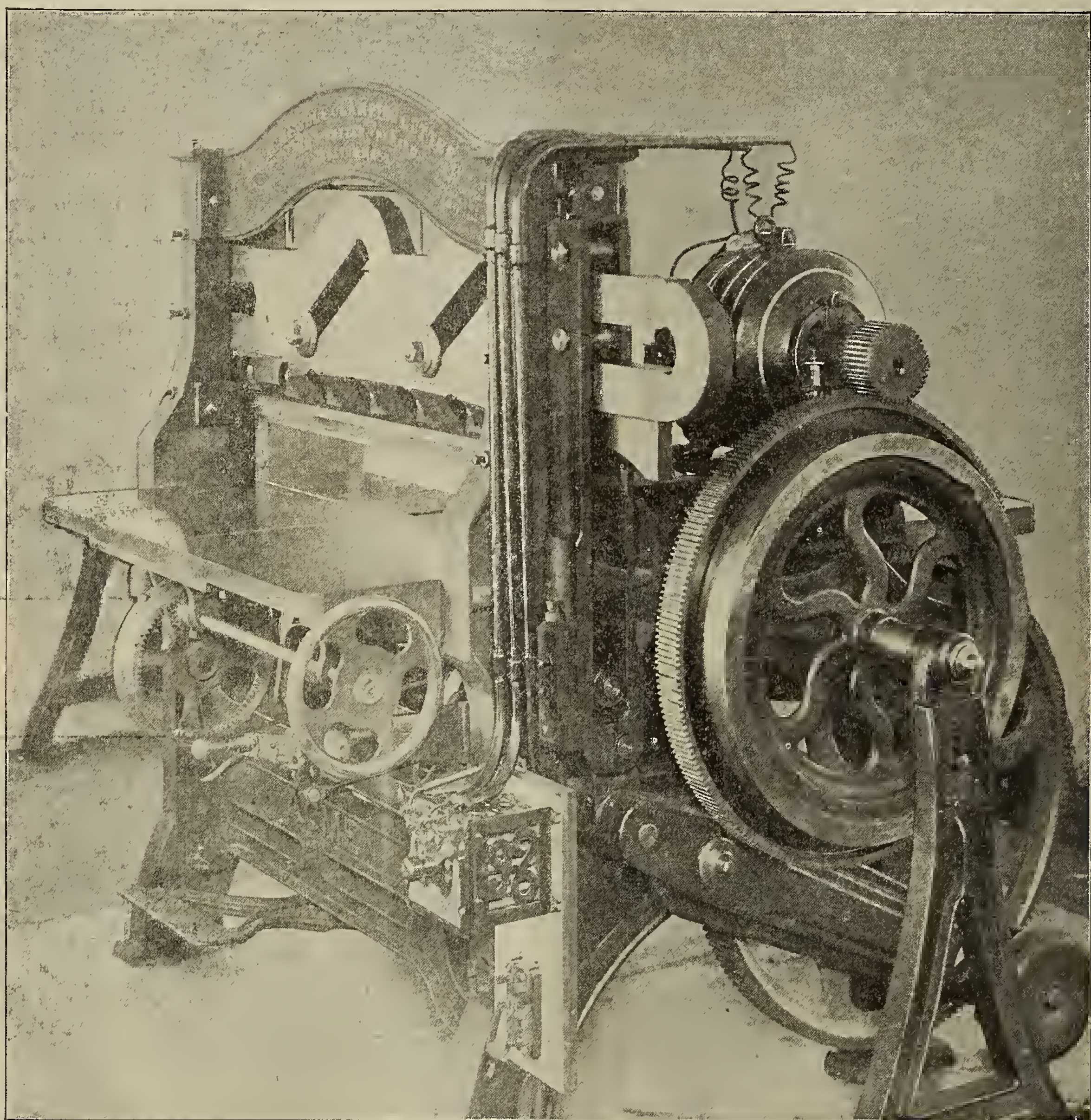
The unique design of the Lundell motor gives it many advantages over its competitors, which are generally admitted. Compactness and a self-contained mechanism, uninjurable and protected, are at once noticeable. The armature, as well as the machine itself, is ironclad. The conducting wires are buried in slots in the armature case, which, with self-oiling bearings, makes the machine practically the acme of perfection.

Perfect control is effected by the operator. A controller giving him the power of stopping, starting, varying the speed and reversing.

Geared motors may be applied to heavy presses or folding machines.

A two-revolution press operated by a Lundell motor merely possesses, instead of a tight and loose pulley, the motor gear with machine attached. The gear is usually supplied with a heavy rim to give momentum to the motor.

Six speeds and two back speeds are obtained by the use of the Lundell controller. More than 125 presses are at present being run by Lundell motors.



Cutting Machine Operated by a Lundell Motor.

Their efficiency is not equalled by others on the market, the figures being from 90 to 95 per cent. in larger sizes and decreasing slightly with the smaller to within a reasonable horse-power. Book binderies, printers and machine shops will not be able to compete in the future without them.

Jules Neher, of Neuhausen, Switzerland, is a guest at the Hotel Duquesne. He is an eminent Swiss electrical engineer. About three years ago he left the Westinghouse electric company, in this city, and started on a tour of the world. He is now about completing the trip, and is on his way to Mexico. During his travels he has made a study of electrical engineering and the advance it has made in the different countries he has visited. He is satisfied that the United States leads the world in the matter of electrical invention and application.—Pittsburgh Post.

Amherst, Mass.—Amherst-Sunderland Street Railway Co.; work will shortly commence on construction of electric road from Boston and Maine railroad station. $20,000 has been practically subscribed for.

CONDUCTIVITY OF INCANDESCENT CARBON FILAMENTS AND OF THE SPACE SURROUNDING THEM.

(Continued from Page 181.)

The lamp shown in Figure 9 illustrates the fact that the heat produced at the positive joints by the "Edison Effect" current is not simply the result of a mechanical bombardment. This lamp was exhausted to show a good blue. The temperature of the filament was raised sufficiently to cause vacuum currents large enough to heat the positive joint red hot. The outer end of the middle wire was then connected to the positive lamp terminal. When this was done the positive joint became cool and the middle wire got red hot. This was repeated several times. The middle wire got hot enough to fuse the end, which was platinum. This indicates that most of the heat is caused by the charged molecules coming in contact with some conductor which will carry away their charge. The current was not measured in this experiment.

Figure 10 shows the lamp used in a similar experiment. The middle wire carried a copper plate about 1 inch long and 1-4 inch wide. This lamp was exhausted to show a good blue. An ammeter was connected between the middle wire and the positive lamp terminal. As the current was gradually raised, the vacuum current heated the copper plate until it was fused, as shown in the figure. The ammeter in this case indicated over five amperes flowing through the vacuous space between the negative leg of the filament and the copper plate.

In this lamp the blue appeared at 136 volts, and remained when the pressure was reduced to 109 volts, but would disappear between 109 and 101 volts.

My next experiment was with a lamp (shown in Fig. 11) having a platinum screen between the legs of the filament and a platinum wire sealed in the side of the bulb and projecting in the vacuous space, with its end bent so as to run parallel with one leg of the filament for about one inch between the filament and the platinum plate. When this filament was heated to about a 2 1-2-watts-per-candle temperature, the vacuum current did not pass around the screen and no blue showed in the vacuous space. That leg of the filament being negative which was on the same side of the screen as the wire which was sealed into the bulb, I connected the galvanometer between this wire and the positive lamp terminal. The galvanometer showed a strong current. On breaking the galvanometer circuit, blue appeared on the positive joint and in the bulb. I repeated this several times. It occurred when the temperature was considerably below the temperature necessary to start the blue around the screen.

In each case, connecting the galvanometer between the wire and the positive terminal would cause blue to appear about the inserted wire and the negative leg, and breaking the galvanometer circuit would cause blue to appear on the positive joint, and in the vacuous space about the positive joint, and about the negative leg of the filament.

Fig. 9.

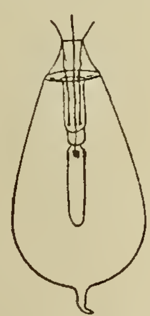


Fig. 10.

Fig. 11.

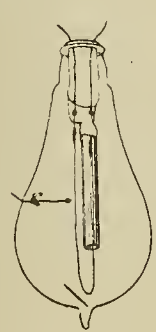


Fig. 12.

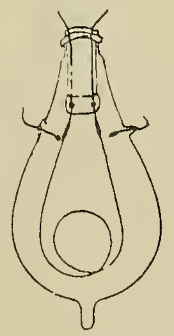


Fig. 13.

I next tried a series of experiments to determine whether the current which passes through the vacuous space when the blue glow is present was the effect of charged molecules moving in straight lines only, from the negative leg, or whether this current would pass around a screen. If a blue glow should appear in lamps with a shield between the legs of the incandescent filament, it would be an indication that the charged molecules under these conditions would carry a current between the two legs in other than straight lines, and if the positive joint should get red hot in such a lamp it would indicate that the charged molecules pass around an obstacle quite freely. For this experiment I used a lamp with a glass plate 2 1-4 inches long and 7-8 inch wide between the legs of the incandescent filament. It was necessary to raise the filament in this lamp to a very high temperature before the blue appeared, and then instead of appearing gradually, as it does in ordinary lamps, it appeared suddenly and in great abundance and the positive joint got red hot, so that it was necessary to reduce the temperature of the filament to prevent the fusion of the joint wire. As the temperature was reduced, the blue gradually decreased, as it does in ordinary lamps.

When the temperature was so reduced that very little blue was visible, the blue would increase gradually again if the temperature was increased. When the circuit was broken, the filament had to be again raised to the high temperature before the blue again appeared.

With this same lamp I observed that when the filament was at a temperature not sufficient to start the blue, if I touched the positive terminal with one finger, and the inserted wire with the other, the blue immediately appeared in the vacuous space about the positive joint and the negative leg of the filament.

These experiments demonstrate that in lamps exhausted so as to show a good blue, the charged molecules have some difficulty in starting their passage from one leg to another around an obstacle, but maintain their passage after it has been once established. Also, that their passage around an obstacle is easily established by starting a flow of charged molecules from the negative leg through a small unobstructed part of the vacuous space, to an inserted wire which is connected to the positive terminal, and then breaking the positive terminal connection.

To determine how large a current could be made to flow around an obstruction in lamps exhausted to show a good blue, I used a lamp shown in Fig. 12, having a glass tube about the negative leg, and the wire sealed in the side of the bulb, running parallel with the positive leg for about 1 inch. I connected an ammeter between the inserted wire and the positive lamp terminal, and raised the temperature of the filament until a dense blue appeared in the vacuous space, and about the wire and the end of the glass tube. The temperature of the filament was raised until the vacuum current fused the platinum wire which was sealed in the bulb. When this occurred, the ammeter indicated 2 1-4 amperes, and remained at this reading one or two seconds.

Any of the lamps in which the condition of the vacuum is just right, showing the blue glow, will show a cur-

rent in a galvanometer connected between the wire inserted in the vacuous space, and the negative lamp terminal, but in all cases this current is small. One-half milliampere is the largest current I have observed under these conditions.

I next tried some experiments with lamps like the one shown in Fig. 13, which has two wires sealed in opposite sides of the bulb, which project inward to a point near the filament about 1 1-4 inches above the joints. This lamp was exhausted to show a good blue. The galvanometer was connected between the wires which were sealed in opposite points of the bulb. No current was indicated until the temperature of the filament was raised quite high, and the blue glow was quite intense.

Under these conditions the galvanometer indicated a current of .1 milliampere.

I have made experiments upon two lamps containing bromine vapor. One of these lamps which contained bromine enough to depress the barometric column one-twentieth of an inch, showed no "Edison Effect" when the potential was run up as high as 170 volts, using a 110 volt lamp.

The second lamp had very much less bromine vapor in it, and showed a very slight "Edison Effect." This lamp acted very peculiarly. When first tried it gave an "Edison Effect" which changed very little in value between 105 and 146 volts. At 120 volts, the vacuum current showed a deflection of the galvanometer of 14 scale divisions, while at 128 volts it showed a deflection of only 12 scale divisions. I observed this several times. This was quite a large reverse change, as the current at 146 volts only increased enough to give a deflection of the galvanometer of 16 scale divisions. This change was observed on several days, but it was less marked each time it was tried, until it finally disappeared.

The question naturally arises, what causes the blue glow in the vacuous space? The glow is luminous, and luminosity can only come from matter; consequently we conclude that the vacuous space, when blue shows, is filled with luminous molecules, and as these molecules are not of themselves luminous, we must seek for the cause of their luminosity.

We have seen that the negatively charged molecules liberate considerable energy on coming in contact with a body that conveys away their charge. We have also seen that when the blue glow is present there is a considerable flow of charged molecules through the vacuous space, and that the naturally rectilineal movements of these molecules are disturbed.

We also know that molecules are emitted from the positive leg about as plentifully as from the negative leg, although these molecules do not carry a positive charge.

The conclusion seems to be that the blue glow is a manifestation of the energy developed by the meeting of the charged molecules with other molecules which take away part or all of their charge.

Well exhausted incandescent lamps which have burned a long time show a black deposit on the inner surface of the bulb. In lamps with thick, stiff, single-loop filaments, in which the two legs lie in the same plane, a light line may be observed in the black deposit, which is caused by the shielding of this line by one leg, from the molecules emitted by the other leg. This line shows with about equal clearness opposite both legs, indicating that carbon molecules are constantly emitted from both legs, equally and in straight lines.

In lamps which have been imperfectly exhausted, the black deposit sometimes appears in patches, symmetrically placed with reference to the carbon. I regard these figured discolorations as indications of disturbances in the rectilineal paths of the molecules, and of the influence of the magnetic field upon the disturbed molecules.

The activity of the molecules carrying current across the vacuous space seems to depend more on the temperature of the filament than on the potential difference between the legs, 40-volt lamps showing about as strong effects as 140-volt lamps. The energy they exhibit in one direction seems to be very much greater than we would expect from molecules actuated by a potential difference of only 40 or 50 volts. The action of these molecules in carrying electricity in one direction only, may be an indication of the nature of the action between molecules in solid conductors carrying currents, rather than an illustration of the action of statically charged molecules.

ELECTRIC RAILWAYS IN EUROPE.

DEPARTMENT OF STATE.

Bureau of Statistics, Washington, February 23, 1897.

Locomotion by means of electricity is gradually gaining ground in the various states of Europe, though not to the same extent as has been the case in the United States, which could hardly be expected, considering the advances in construction and working of the different systems employed there.

During 1895, the total number of electric railways, or tramways, in Europe rose from 70 to 111; the length of lines from 700 to 902 kilometers (435 to 560½ miles), and the power of the "centrals" from 18,150 to 25,095 kilos watt, while the number of cars are increased from 1,236 to 1,747.

In mileage of electric railways, Germany is foremost among European nations, having 406 kilometers (252 miles) of lines; then follow France, with 132 kilometers (82 miles); Great Britain and Ireland, 107 kilometers (66½ miles); Austria-Hungary, 71 kilometers (44 miles); Switzerland, 47 kilometers (29 miles); Italy, 40 kilometers (24¾ miles). Servia, Russia, Belgium and Spain have but from 10 kilometers (6.21376 miles) to 30 kilometers (18.64128 miles), while the remaining countries have less than eight kilometers (4.971 miles) each.

Of these 111 lines, 91 are worked on the overhead surface system, 12 on the underground system, and eight by means of accumulators.

A large number of electric railways which were building during 1895 have been finished in 1896. It is estimated that the new lines of the present year will exceed in number and mileage those constructed in 1895, and it would appear from the activity shown in planning and laying out new routes that next year will show a like increase.

The capital invested in Germany alone in electric lines is estimated at 100,000,000 marks ($23,800,000). German industry and German capital are responsible for the advance shown in this new departure in the Empire. It is due in a great measure to the Rhenish-Westphalian iron industries having been for years trained in the production of street-railway material, both for the home and foreign market.

German electrical companies and supply manufactories have greatly increased in number and capital during the past few years and are constructing electric lines with steam engines down to the smallest isolator, thus giving an impetus to the boiler and car manufacturers.

Among the larger cities, Berlin is just about to introduce general electric locomotion in its streets. At present it is almost entirely dependent on the old horse tramway and omnibus service. Hamburg and Leipsic have their electric street railways nearly completed.

The overhead surface system, owing to its being cheaper than the two remaining systems, will continue to be preferred for the lines contemplated or in course of construction.

Thos. Ewing Moore, Commercial Agent.
Weimar, December 3, 1896.

The Electrical Age.

ESTABLISHED 1883.

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CONTENTS.

ENGINEERING IN CUBA.

The present revolution in Cuba has probably swept away the last traces that were left to remind us of any progress that had been made there in electric lighting.

On the great sugar plantations it was found profitable and convenient to use electric lights. The crushed cane supplied endless fuel and the sugar machinery necessitated the attention of men perfectly capable of accepting the additional care of a dynamo.

Now that the island has been devastated and the sugar growing centers temporarily destroyed, there will be a delay in prosperity. But when peace has been restored, and particularly when independence has been gained, the old industries will be resumed. The active American engineer will find in Cuba a field for his efforts that are too broad for outline. The sluggish trade carried on between the United States and Cuba brought great profits to the few firms that engaged in importing American electric light apparatus.

It seems that an engineer could make great headway in this budding island when things quiet down permanently. The Spanish for the last few years had so harassed commerce that it was decaying even before the last eventful crisis occurred. Every plantation in Cuba, as well as every large town, needs and can support electric lights; Havana particularly.

It would be an excellent plan for some of your friends to look over the ground and see whether the opportunities there are not first-class.

EFFECTS OF COLD UPON RESISTANCE.

The safe carrying capacity of a wire is determined by its temperature when the current is flowing. Should this rise to a dangerous point, the insulation is threatened and the risks of fire become accentuated.

A wire stretching between supports at the Equator would be less capable of carrying a current without injury to its insulation than a similar conductor suspended somewhere near the scene of Nansen's return.

Cold merely assists the wasted energy in escaping and therefore prevents an accumulation of heat within the wire. But there is another phase of this case to be considered. A conductor exposed to different temperatures is found to possess different resistances, the resistance increasing and decreasing with its rise and fall. When the wire is red hot and then heated further, its resistance becomes exceeding great. Conversely the application of cold makes the resistance lower and lower. An eminent authority in England states that all metals have the same specific resistance at a certain exceedingly low temperature.

This remarkable discovery more than ever inclines us to believe that the molecular grouping or intermolecular spacing, completely governs the resistance of a metal. It was once suggested that resistance in any conductor is due to the distance leaped over by the current, which in this case is divided up into millions of minute charges. Were it possible to so control these spaces that in several specimens of metal they could be made alike, then according to this theory, each would have the same resistance.

The change in resistance due to changes in temperature probably indicates the best experimental method of investigating the mechanism of conduction.

Swan Light Patents Expiring.—The Swan Incandescent Electric Light Company of 14 White street has applied to the Supreme Court for the voluntary dissolution of the company. The following directors united in the application: Mayor W. L. Strong, Edwin Einstein, Emanuel Einstein, David L. Einstein, Charles W. Spear, Morris Tatman, and Felix Samson. The company was incorporated in 1882, with a capital stock of $800,000, to manufacture and sell electric lamps under the patent of Joseph W. Swan. From 1885 until two years ago the manufacture was carried on by a licensee, the Swan Lamp Manufacturing Company of Cleveland, O., and the only source of revenue was the royalty. Two years ago the licensee discontinued business, and since then the company has had no income. It was unable to begin the manufacture on its own account now and as the patents expire this year the directors deemed it advisable to wind up the company. It has no liabilities, and assets $6,903 in cash, patents, and a safe.—N. Y. Sun.

Electric Power from a Canal.—A scheme to develop from 100,000 to 200,000 horse-power by building a canal from the St. Lawrence river to the Grass river, in St. Lawrence county, has recently come to light. It has taken long months of work on the part of the New York men who were pushing the enterprise to secure the necessary capital. It is now understood that they have managed to place bonds with certain English capitalists, and the work on the proposed canal will begin at once. The St. Lawrence is to be tapped two miles below the southern end of Long Sault Island, and the canal will run over a comparatively level plateau till it reaches a drop of about forty feet at Massena, on Grass river. Here the turbines will be put in and an electric plant will be erected to generate the horse power. The canal will be about four miles long, three hundred feet wide and twenty-five feet deep if it is decided to obtain only 100,000 horse-power. John Bogert, the consulting engineer, estimates the cost of such a waterway at $1,000,000. Lieut. James Patton is designing the electrical plant.

TRACK AND TRACK JOINTS: CONSTRUCTION, MAINTENANCE AND BONDING.

M. K. BOWEN.*

I.

After signing a contract to tell my associates in business how to construct and maintain a street railway track, I began to cast around for data bearing upon the subject, and found that the life of a rail was measured by the wearing out of the head, and less than twelve per cent. was worn away before we sold the old rail for scrap, hence the deduction that the point of contact between the wheel and the rail, in other words, the bearing and wearing part of the track, was the most important consideration. I asked a wheel manufacturer why wheels of street railroad cars were made conical or bevelled shaped instead of flat. His answer was "To draw out of the mould of course." Not being satisfied, I asked a steam railroad man the same question. He said it was for the purpose of compensating on curves for the further travel of the outside wheel.

If I had asked a street railroad man the same question he would have promptly and correctly answered (even if he did not know and had to guess), that the bevel on a car wheel was for the purpose of centering the car on the track, providing a means for a lagging wheel to catch up again, maintaining the axles of the car at right angles with the rail of track. The foundry man was wrong, because we all know that flat wheels can be made. The steam railroad man, when he answered, had in mind his 10-degree maximum curve; but in applying his answer to our conditions he was wrong, because on a quarter circle curve of 50 foot radius, 30 inch wheels, the outside wheel is compelled to travel 7 feet 4 3-4 inches farther than the inside wheel, and the absurdity of the bevel of 1-4 inch on a two-inch tread compensating for this travel, and preventing slipping is readily apparent, as it would require a bevel of 1 11-16 inches in a two inch tread to compensate for the difference in travel of the wheels. The effect of the slipping of wheels on curves is clearly shown by the brightness of the rails, showing abnormal wear.

The street railroad man was right, because if he stands behind any of his receding cars he notices the movement of the car from side to side with a rhythmic motion, which tells of an action taking place. The analysis of the action develops a coal-saving, wear-saving movement, always at work; a sort of a silent partner producing part of your dividend, for if this motion did not exist the wheel which once got behind, an axle which once assumed a position not at right angles with the truck, would be apt to remain in its faulty position during the entire trip, requiring excess of power to haul the car, and abnormal wear of wheel and rail, resulting in sharp flange wheels and short life of rail.

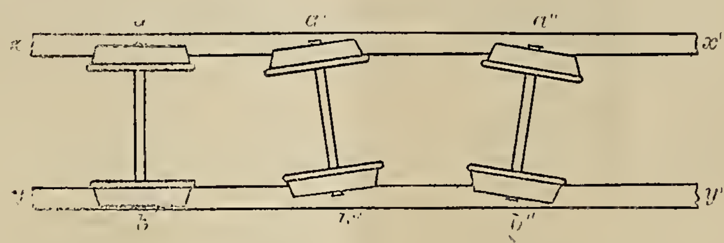


Fig. 1.

II.

The action taking place is this: Suppose the car has shifted toward the rail Y Y , Fig. 1. This action causes the wheel (a) to bear upon its smallest diameter, and the wheel (b) to bear upon its greatest diameter, with the result that (b) runs ahead of (a). This brings the axle at an angle with the rails, as shown by (a′) (b′). The wheels will now tend to shift to the opposite side, X X′; the wheel (a) will rest upon its largest diameter, while the wheel (b) will rest upon its smallest diameter, when (a′) will start and run ahead of (b′) bringing the axle into position shown by (a″) (b″), and so this action keeps up continually, tending always to keep the truck in the centre of the track.

If the wheels had no bevel the result would be that, unless the rails were exactly on the same level, the car would shift to one side, the result you all know.

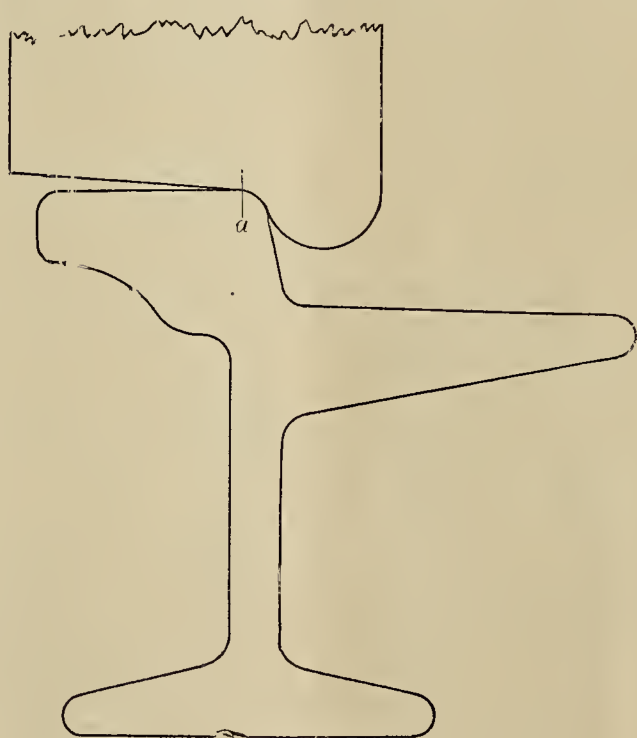


Fig. 2.

III.

Take first a conical wheel running on a rail the surface of which is level. Referring to Fig. 2 we note that the rail and wheel make contact only at the point shown at (a). This is the state of affairs when the rail and wheel are new.

*Read before the American Street Railway Association St. Louis Convention, October, 1896.

In a few months, if we again examine our wheel and rail, we will not find them the same as when we first looked at them. We now observe that the wheel is badly worn next to the flange, while the inner edge of the head of the rail has flattened to a considerable extent and worn down. Both the wheel and the rail are doing their best to come to a common bearing surface, but it is at the expense of scrap wheels, of which only half of the tread has been worn through the chill. It is quite plain that the rate of wear must be enormous at first, for the whole weight of the car is brought to bear upon a very small surface (a, Fig. 2), almost a point I might say. This rate of wear steadily decreases as the surface of the rails and wheels wear themselves away until the contact between the two is a line the whole width of the rail, and not merely a point. But long before the surface of the rail has conformed to the surface of the wheel tread, where the best form is attained, the head of the rail has lost a large percentage of the metal allowed for wear, and as wheels wear faster than rails, it has taken in some cases thousands of quickly worn-out wheels to bring the rail to its final and best form.

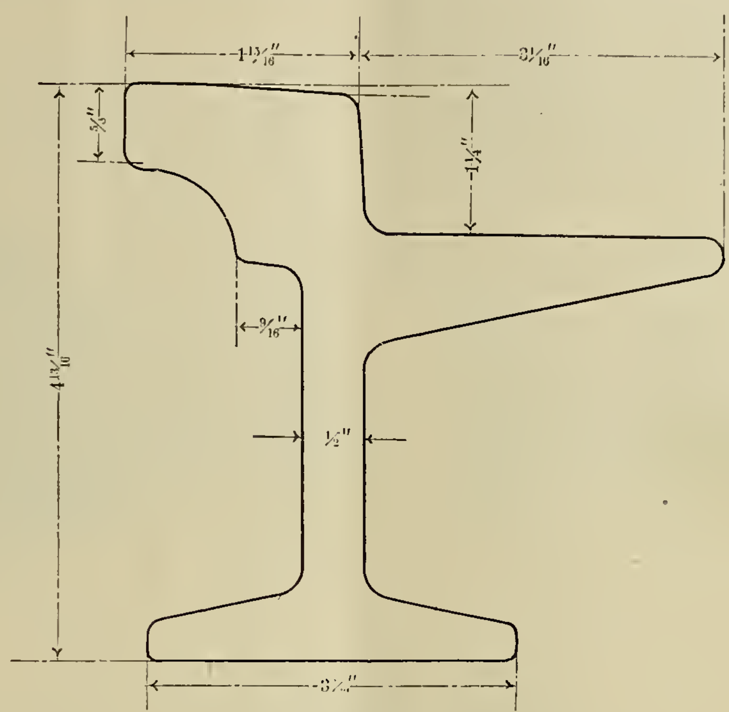


Fig. 4.

Figs. 3 and 4 show sections of the rail now in use on the State Street cable line, the height of the head being 1 3-16 inches. The first rail put in State street, Chicago, had a head 3-4 inch high; this was increased to 1 inch, and later to 1 3-16 inch; it is beveled to conform with the bevel of the car wheel for two-thirds of its section from gauge line across head.

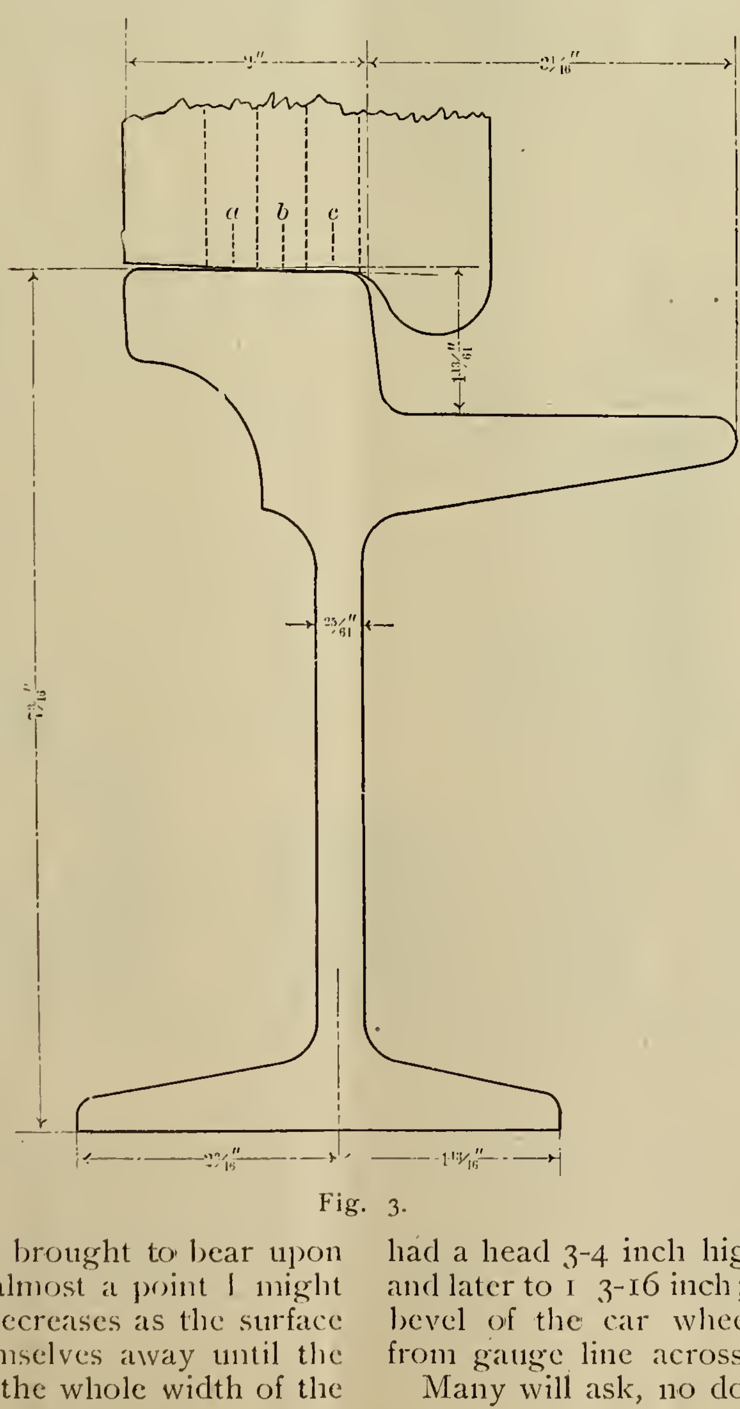


Fig. 3.

Many will ask, no doubt, if there is not a slipping of

the wheels on the rails, due to the unequal diameter of the wheel at all points. There is, imagining the wheel divided into three parts at right angles to its axis (Fig. 3) and each piece free to move by itself, and whose diameters are situated at a, b and c, respectively, it is quite evident that as the portion (a) makes one revolution it will travel over a less distance than the portion (b) would, and similarly the portion (c) will travel farther than the portion (b) in one revolution; but, on account of it being all one, the portion (a) travels farther than it otherwise would, thereby causing it to slip; the portion (c) would travel a less distance than it otherwise would, thereby causing it also to slip.

The above is based on the supposition that the car would move a distance equal to the circumference of the wheel at the point (b) in one revolution of the wheel. But this waste of power due to slipping is very slight, for, considering the coefficient of friction as .15, we find that for a ton mile the energy lost by this slipping is .0104 H. P.; so small in fact, that on account of other advantages it may be ignored.

The experience of the Chicago City Railway Company, who first tried this form of head, has been that it saved wear of both rails and wheels, increasing their life by about 35 per cent. Why not, in building a track, put in rails which are beveled to conform to that of the car wheel at the first, and not spend time and money wearing the wheel and rail down to fit each other?

Fig. 5 shows a section of a new and old car wheel which shows clearly the manner in which the tread of the wheel will wear if used on a rail with no bevel. The record of car miles of this wheel is not known, but no doubt a great amount of energy was lost before it had worn down to its most economical state.

(To be Continued.)

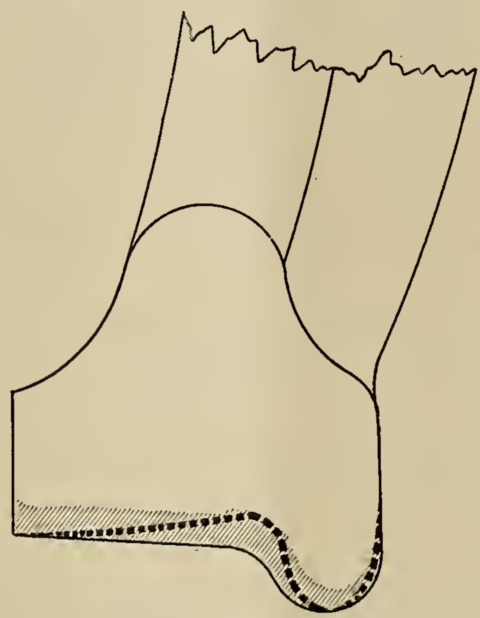


Fig. 5.

The Telescriptor.—The "telescriptor" is the name given to a recent invention, for which is claimed the power of transcribing messages sent over a line, the object of the invention being to furnish expeditiously a permanent record of such messages as are ordinarily sent by 'phone. It is claimed that the scheme can be applied to existing telephone systems, so that, for example, a correspondent in New York wishing to communicate with his Philadelphia office would simply call up the Philadelphia end on the 'phone; then, by switching the circuit over on to the sending apparatus, which is described as being in the form of a typewriter, and operated in the same manner, he writes out his message, which is printed at the Philadelphia end. The specific advantages claimed are that the message is furnished in permanent form, and communication is much more expeditious than by telegraph, since it is direct, there being no delivery at a central office and subsequent handling by messenger boys.—Philadelphia Ledger.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—TELEPHONE SYSTEM WITHOUT CENTRAL.

Senate Chamber, Mandan, North Dakota, 3, 14, 1897.
Electrical Age, New York, N. Y.

Gentlemen: Kindly inform me on the following point:

Is there any system of telephone that can be successfully used in small towns, such as this, where there would probably be 50 or 100 'phones, without the "central" office?

Yours truly,
J. S. Green.

(A.)—By writing to the American Signal and Power Co., of Minneapolis, Minnesota, No. 27 Reeves Building, you will be able to obtain some information in relation to the system you desire to install.

The object of the above company is the entire abolition of a central office system, making communication independent of any intermediate centre.

(Q.)—X-RAYS FLUOROSCOPE.

1015 William Street, Omaha, Neb., Feb. 10, 1897.
Electrical Age Publishing Co., World Bldg., New York:

Gentlemen: Would you kindly give directions in your Inquiry Column for making an X-Ray Fluoroscope. If directions should take too much space, kindly mention name and price of book giving such directions and oblige

Yours respectfully,
John G. Rosicky.

(A.)—A cheap fluoroscope can be made by using powdered sugar upon a piece of cardboard and tacking it upon the inside of a box. Many salts fluoresce when exposed to X-Rays. The tungstate of calcium salts can be bought at any druggists and applied as described above.

(Q.)—ELECTRIC FORGING.

Montreal, Mar. 20, 1897.

Electrical Age:

Dear Sir: The forging establishment I am proprietor of would not be injured by the introduction of a few novelties. I have heard of a method of heating metals by electricity that is considered "out of sight." Your kindness in describing it will be deeply appreciated.

Yours respectfully,
Owen Rankin.

(A.)—In Niagara the blacksmiths have a forge consisting of a water trough and a pair of tongs. At the bottom

of the trough is a metal plate connecting with a wire. The tongs are likewise in contact with a wire. Anything dipped in by the tongs becomes white hot in a few moments. By corresponding with the Power Company at the Falls you will be able to receive more definite information.

LABORATORY APPARATUS.

The Junker Gas Calorimeter.—The Gas Exposition contained many new and interesting contrivances that could not fail to impress the observant visitor with their value to the consumer and manufacturer.

Eimer & Amend, established since 1851, of Nos. 205, 207, 209 and 211 Third avenue, were among the foremost in their display of special apparatus for testing the heat units produced from a given volume of gas.

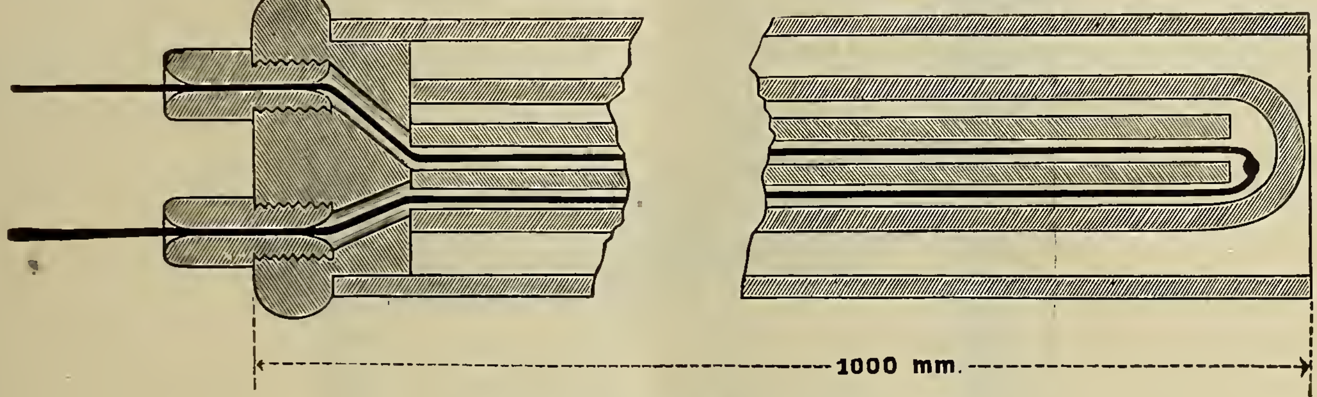
The Junker Gas Calorimeter attracted considerable attention. It is designed for practical use, measuring the caloric output during combustion of such liquids as petroleum, naphtha, alcohol, coal, wood, etc. It is a very unique instrument as regards its ability to measure the heat generated by the consumption of food in the body.

The standard of such tests is the number of calories produced per unit volume of the gas. Besides this, the calorimeter can be used as a means of measuring the economical value, and consequently for fixing the price of the gas.

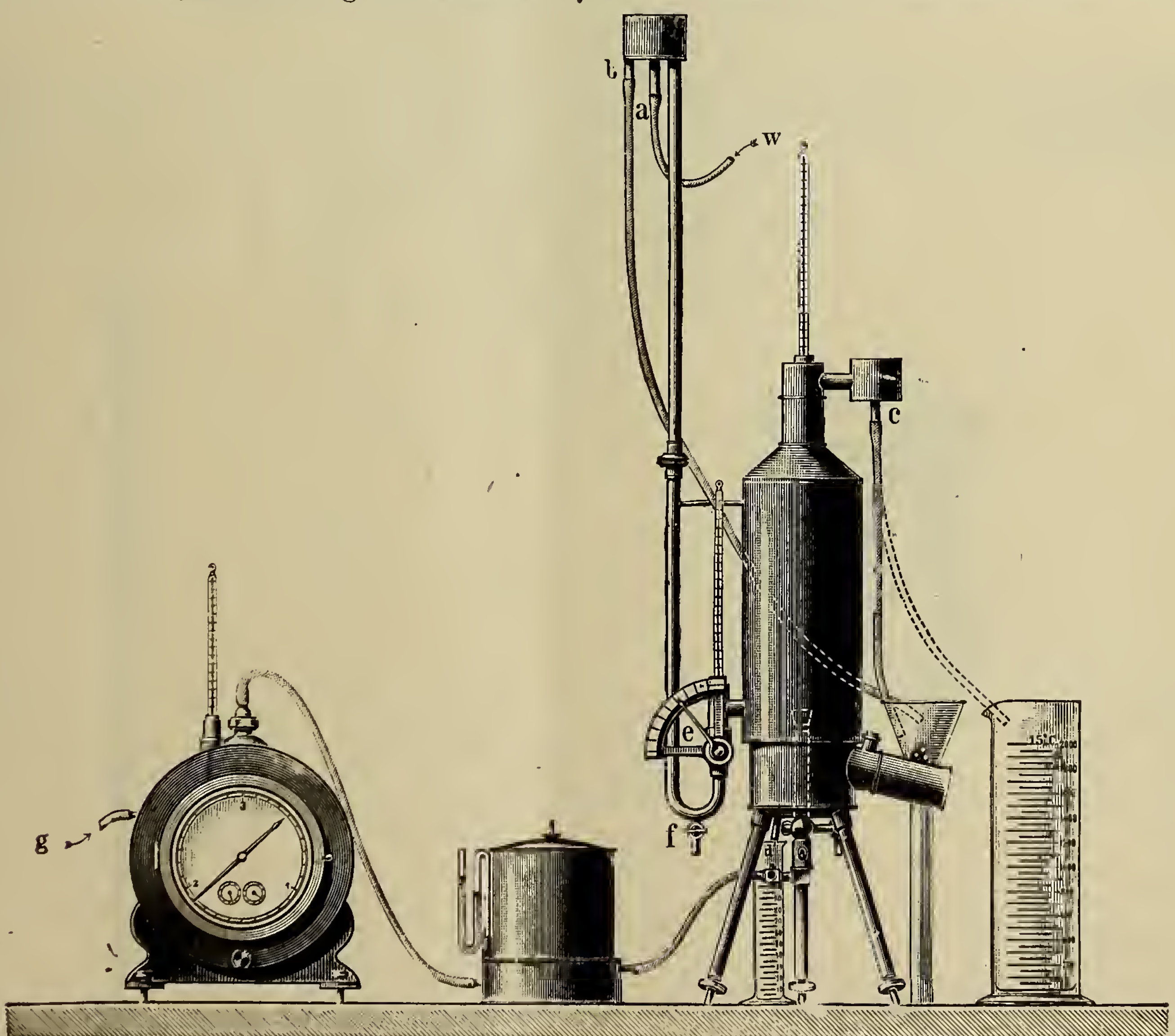
The illustration gives a general idea of the parts of the calorimeter:

(a) Connects with the water main.
(b) Connects with an overflow pipe.
(c) Nozzle discharging water from calorimeter.
(d) Tube carrying off the water of condensation.
(e) Regulating cock.

Additional explanations of the apparatus can be found in the catalogue issued by Eimer & Amend on this subject in relation to calorimetric devices.



New Platin-Rhodium Pyrometer.



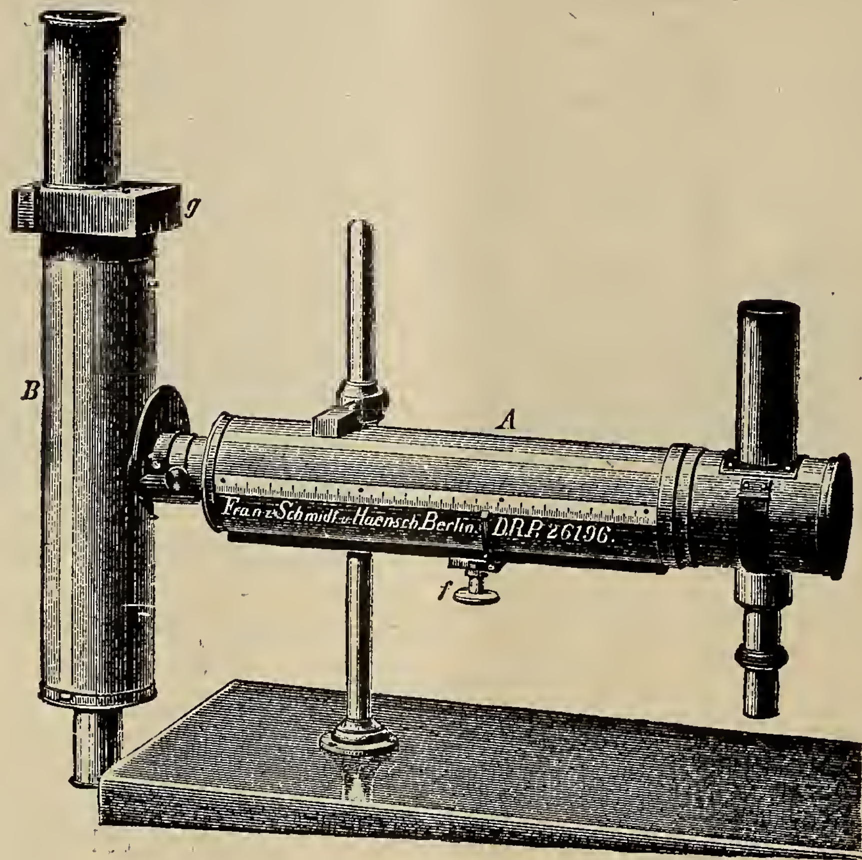
Junker Gas Calorimeter.

New Platin-Rhodium Pyrometer.—The means employed for the measurement of high temperatures are inaccurate and scarce. Two good methods are in vogue, one by Sir Wm. Siemens, which involves the use of pure platinum; the other, by Mr. Le Chatelier, making use of a thermo element, made of platinum alloyed with platinum-rhodium.

The wire element contained in the porcelain tube is exposed to the heat. The galvanometer gives the tempera-

ture up to 2920 degrees Fah. This outfit is particularly fine for careful heat tests.

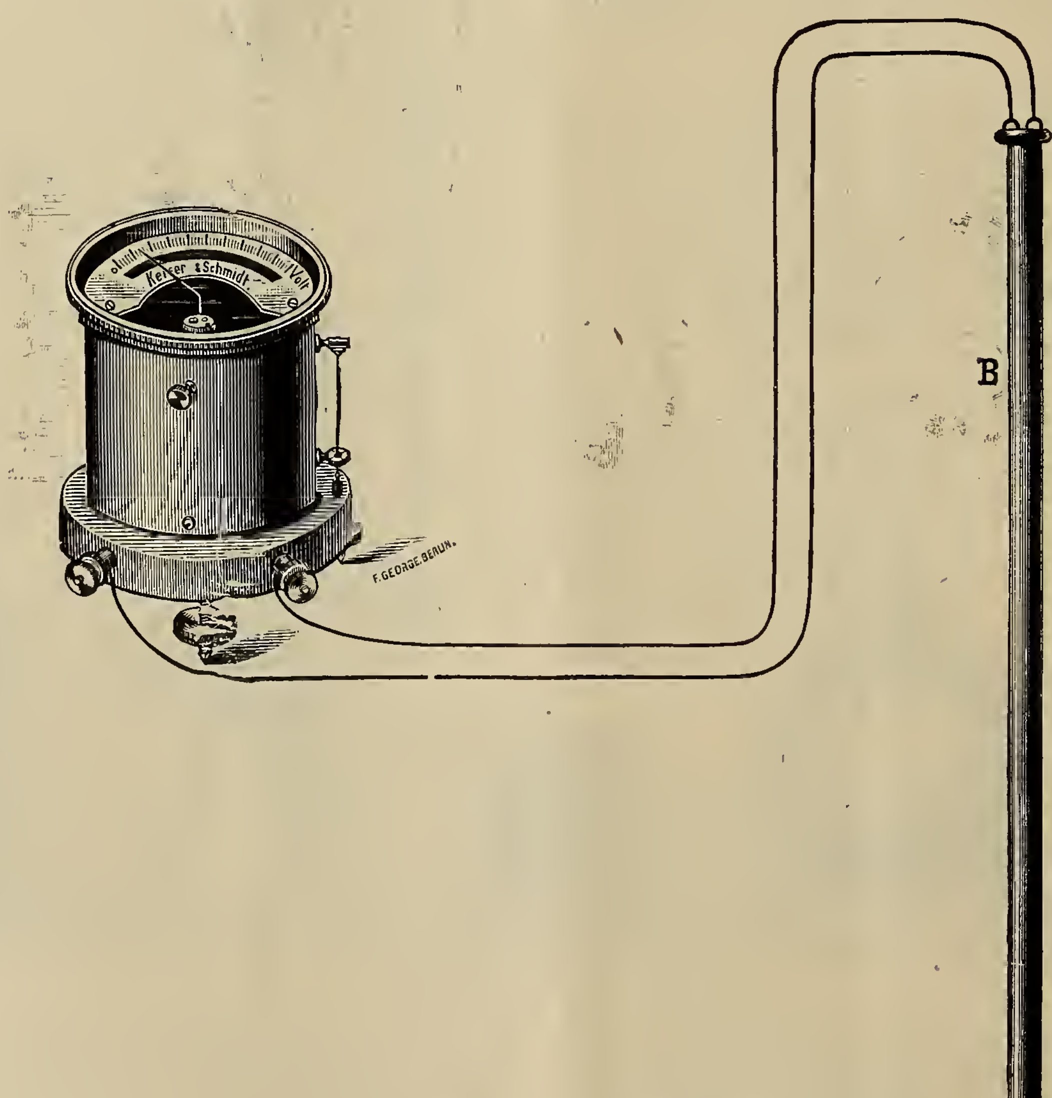
Weber's Opal Glass Photometer, used for measurements of light from either arc or incandescent lamps, is a very meritorious instrument in the respect of being able to determine the light emitted at different angles.



Standard Photometer with Lummer-Brodhun Prisms.

Its portability is a great advantage, as it can be carried in a case 22x10 1-2x6 inches. It gives, direct in candles per square meter, the value of the illumination from the popular standpoint of comparison.

Telephone Wires and Lightning.—Telephone wires seem to have an important influence in preventing lightning from striking, according to the investigations of the German telegraph department. Three hundred and forty towns with telephone systems and five hundred and sixty without them were under observation. In the former the lightning struck three times for every hour of the storm, in the latter five times. Moreover, the violence of the lightning was much less in the former case. —Philadelphia Record.



Pyrometer set up with Galvanometer.

INCANDESCENT LIGHT AND EDISON SYSTEM.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The history of electric lighting is not very old. Its different branches have developed to such an extent that some of the heaviest investments of this country are made in electric light plants. The electric light systems of this country may be divided up into two general branches

Incandescent Lighting.
Arc "

Under the heading of the first we are prepared to consider the development and present condition of incandescent light systems.

Kinds of Lighting.—The lighting of incandescent lamps effected either by continuous or alternating current. An incandescent lamp only calls for a certain pressure and current; when these are supplied the lamps at once become normally bright and the problem of incandescent lighting, as far as the light is concerned, is complete. There are, however, certain stringent reasons for observing such limits as are imposed by circumstances, and which prevent the attainment of more than a limited light without extraordinary expense. That to which reference is made is the line circuits which carry the current, and which by their arrangement practically gives the system of lighting its name. The success of incandescent lighting depends entirely upon the size, length and support of the line as well as the nature of the dynamo and its additional attachments. The most common system of incandescent lighting known is the Edison. There is in this system certain features which have made it the superior of all others. The reason for this is due to the fact that all the wiring represents a network of squares, arranged in such a manner that one point is at the same pressure practically as any other. The secret, therefore, of successful incandescent lighting is the power of retaining a uniform voltage at all points.

Basis of Lighting System.—Any wiring system which will allow a uniform pressure to prevail throughout is valuable in two respects.

(a) Lamps are saved.
(b) Light is constant.

Under the conditions mentioned the long life of a lamp is assured. There is no greater cause of breakage in lamps than the rising or fluctuating pressure in the lamps. Again, from a purely commercial standpoint, the constancy of the light is so important that unless some means is taken to keep it constant, customers cannot be retained, and the damage caused by this double difficulty becomes irreparable.

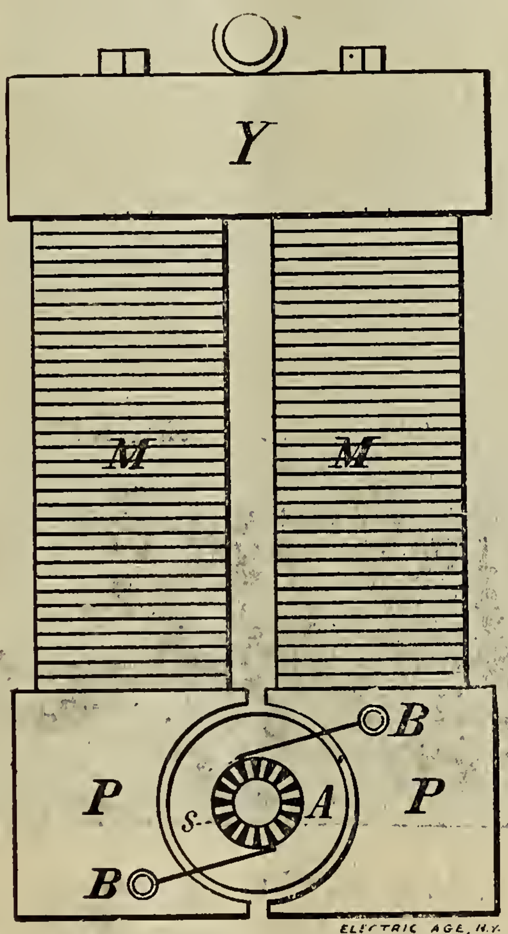
Function of the Dynamo.—To keep the pressure constant in the line the dynamo itself must preserve a uniformity of pressure, or at least within very slight variations. The line depends upon the dynamo, but by means of an ingenious arrangement the dynamo can be also made to depend upon the line. By the two affecting each other we have a system sensitive to outside changes. Compound winding enables us to retain the pressure about constant, or at least to raise or lower it when so desired. This at once brings us to a consideration of the cause of such changes.

Regulation.—The dynamo would not require any extra device if the load upon it were constant, but the continual changes affect the dynamo as follows: When the dynamo is supplying 110 volts and a load of lamps are thrown on, the pressure may fall to 105 volts, due to the

drop in line,
armature reaction,
drop in armature.

Conversely, if the dynamo is laboring under full load and the lamps to a large extent are removed, the pressure will rise from the point it is at and perhaps cause serious injury to the remaining lamps. A regulating device is therefore necessary when circumstances cause such rapid changes as these. The device used is in itself simple enough.

Compound Coil.—A rise or fall in volts is due to the conditions enumerated; a loss of volts in the armature, a loss in the line and armature reaction. These three



Parts of Dynamo.

Y	Yoke
M M	Magnets
P P	Poles
B B	Brushes
S	Segments
A	Armature

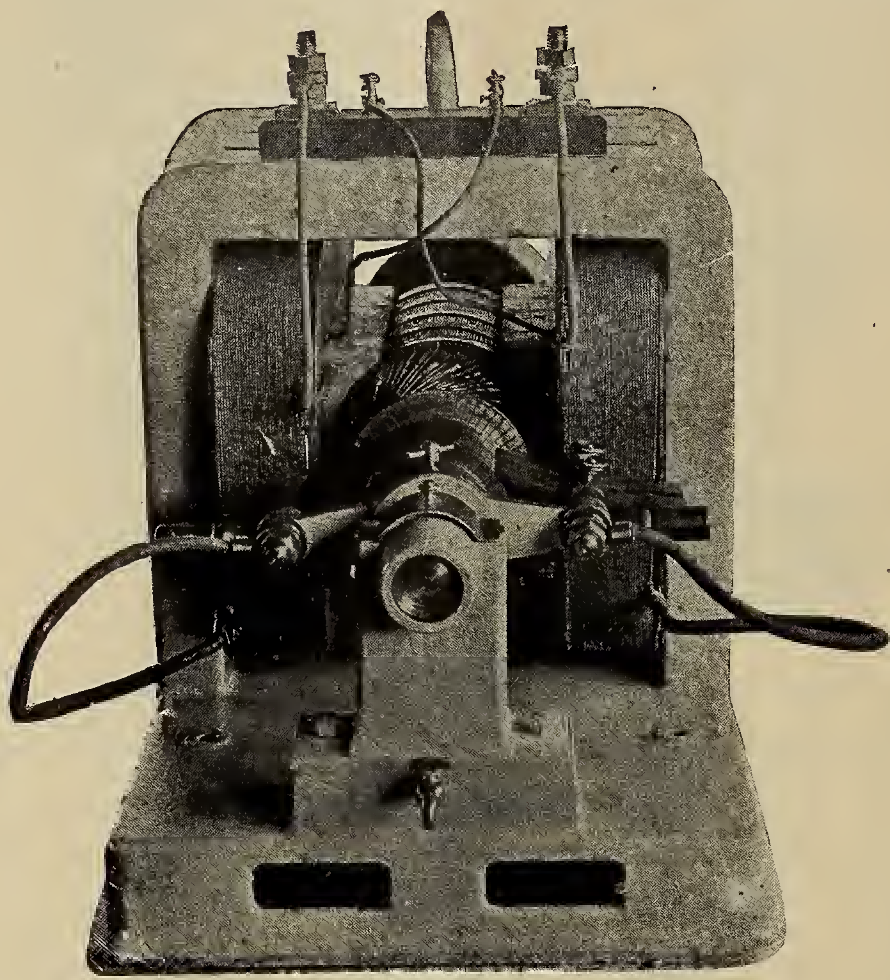
factors pull down the voltage considerably, and their combined effect is very noticeable with each increase in the number of lights.

To compensate for this loss the dynamo is made sensitive to the changes of load in a very simple manner. A coil is wound around the magnets of the dynamo of large enough wire to carry the current of the line; when the current in the line increases the ampere turns due to this winding increase also, and the dynamo has its pressure increased because the ampere turns have strengthened the field.

If these changes are automatic the dynamo will adjust its potential to the number of lamps and always be high enough to keep them at normal candle-power. The ease with which this arrangement works is surprising; it is in popular use in every isolated as well as central station plant.

The success of incandescent lighting depends upon a wiring system that causes as little loss as possible with the greatest possible variations in current.

The Edison network is the nearest approach to perfection of anything we have. It consists in the main of three parallel webs of wire; between each two adjacent webs there is 110 volts pressure, and between the two most apart, the first and third, 220 volts. The economy of saving one wire and yet having two lighting circuits that are independent, yet in close combination, is obvious. The two outer circuits, between which there is always 220 volts, are greatly used for motors. When the same number of lamps exist on each side of the middle web of wire the system is said to be balanced. The web-like formation is due to the fact that the wire is distributed through streets, which give it the shape of a netting with square meshes, each mesh including one block.



Latest Type Ironclad Dynamo.

LIEBER'S STANDARD CODE.

Published by the Lieber Publishing Company, 2 Stone street, New York; 112 Queen Victoria street, London, E. C.; 21 Rue Auber, Paris; 123a Potsdamerstrasse II., Berlin.

The following are some of the advantages of Lieber's Standard Code of 800 pages, containing nearly 75,000 phrases, 25,000 of which are arranged in tables. There are 10,000 extra Ciphers, giving ample opportunity for special phrases.

(1.) The alphabetical order of the sentences, e. g., "Can execute order." "Has the order been executed?" and same can be very quickly found—see other Codes.

(2.) The extra blanks, left after each special subject, available for private phrases.

(3. Each Code word in the tables (see pages 653–793) signifies in one word, sentences which other Codes use two or more words to express.

(4.) The Code words are taken from the "Official Vocabulary" of selected ciphers, the use of which will soon be compulsory.

(5. The ciphers in Lieber's Code embrace only those commencing with the letters A to E inclusive, so that Lieber's Appendix or any private Code can be used in conjunction with it for Ciphers commencing F–Z, and without the least chance of conflict.

(6.) Lieber's bi-monthly Manual contains a list of the users of Lieber's Standard Code, which of itself is a positive advantage; similar to a telephone directory.

(7.) The numeral (pages 711–717 and 749–757) are more exhaustive than any other Code, e. g., 16¼, 24½, etc., can be telegraphed in one word.

(8.) The personal pronouns "I" and "We" are omitted in the dialogue, thus admitting freer use of sentences. In many Codes the sentences containing "I" and "We" are not available most of the time when it is required to apply expressions to the third person.

(9.) The double and treble indexing of the subjects, e. g., "15th of July," will be found in the Index under "Calendar," "Days of the month," "Months—days of." For "£" look under "Pounds (£)," "Sterling," "Money."

(10.) The foregoing give instances of a few of the particular advantages of Lieber's Standard Code, which, with others, have evoked the unreserved endorsement of numerous financial and commercial houses, not only in the United States and Great Britain, but in all other countries where prompt, efficient and economical transmission of telegraphic business is required. Its superiority over all other Codes has been acknowledged both by the press and

by those who are now using Lieber's Code, not only as to secrecy and economy, but also as to its perfection of classification.

Sent postpaid on receipt of price, $13.

Upon request a representative will call upon you with a copy of the Code and explain in detail its advantages.

POSSIBLE CONTRACTS.

Martinsburg, W. Va.—Address the mayor concerning $50,000 worth of bonds to be issued for an electric light plant.

Wolfborough, N. H.—Town Clerk may be addressed concerning construction of electric light plant.

Westboro, Mass.—Work is about to commence on the construction of the Westboro Electric Railroad, and a large force of men are now at work cutting poles and sleepers.

Cincinnati, Ohio.—The Cincinnati, Hamilton & Dayton Traction Co., are endeavoring to secure franchise to construct new electric railroad through the village of Carthage and over the Springfield Pike.

Springfield, Mass.—The Amherst-Sunderland Street Railway Co., will erect an electric plant at North Amherst, which will be driven by water power from Dwight Graves' dam.

Altoona, Pa.—Local capitalists will build a new electric road to Elmwood, at a cost of about $75,000.

Ayer, Mass.—William M. Sargent will erect new building, and put in a larger dynamo to furnish electric lights.

Lansing, Mich.—An electric railway will probably be constructed from Standish to Au Gres.

Washington, La.—City Clerk, may be addressed concerning electric light.

Mansfield, Mass.—The Mansfield & Easton electric road will be built immediately, to connect with the Brockton system.

Winsted, Conn.—Henry Gay, may be addressed concerning construction of trolley line between Winsted and Torrington.

Watertown, Mass.—The Newton Street Railway Company has been granted permission to lay tracks and operate cars by electricity on Pleasant and Bridge Streets, in that town.

Thompsonville, Mass.—An electric road is to be built from Thompsonville to Somerville, and surveys for same are now being made.

St. Cloud, Minn.—F. M. Wright has put in a 15 horse power electric motor in his wood working factory on St. Germain Street, West.

Portland, Me.—The Portland and Rochester Railway officials contemplate the construction of a trolley line.

North Eastern, Mass.—Taunton & Brockton Street Railroad Co., meeting of selectmen held recently regarding construction of electric railroad.

Greenup, Ky.—John L. Soward may be addressed concerning electric light plant.

DRY BATTERIES.

The first cell that attracted any attention in this country was the "Gassner," and a few thousand cells of that type were imported and sold at a very high price.

The enterprising house of J. H. Bunnell & Co., 76 Cortlandt street, with its usual foresight believing that an efficient dry cell would find a ready sale, promptly put one on the market and they are undoubtedly the pioneers in bringing out the first practical, American made dry battery.

The excellence of this battery, together with the able manner in which it was handled, soon made it an acknowledged commercial success. This success naturally attracted some piratical imitators, who copied its appearance in every possible particular; but, notwithstanding the fact that it was handicapped with a heavy royalty, the Bunnell & Co.'s battery, on account of its acknowledged superiority, has continued in the lead and its sales are estimated to have reached about a million cells.

Dry Battery of J. H. Bunnell & Co.

Messrs. Bunnell & Co. have recently extended and improved the facilities for making their Mascot dry cells, and the quality of these cells is guaranteed to be the best for strength, durability and recuperating powers; and the low price at which they are now being quoted would seem to justify the prediction that their Mascot dry cell will soon supersede wet cells for all open circuit work.

Raleigh, N. C.—The Raleigh Electric Light Co., will build a $35,000 electric light plant, to take the place of the one which was destroyed by fire last summer.

Lancaster, Ky.—G. M. Patterson has been awarded contract for the establishment of an electric light plant.

St. Louis, Mo.—Robert E. McMath, President Board of Public Improvements, may be addressed concerning lighting of streets of this city with incandescent arc electric lights, for which bids are being invited until April 9.

Hancock, Mich.—Village Clerk, may be addressed concerning erection of electric light plant.

Washington, La.—A. J. Muller, Mayor, may be addressed concerning erection of $15,000 electric light plant.

Hartford, Conn.—The Central Railway & Electric Co., survey of road is being made.

NEW CORPORATIONS.

San Francisco, Cal.—Acme Electric Manufacturing Co., has been incorporated by W. T. Y. Schenk, M. S. Schenck, L. St. D. Roylance, S. R. Peterson, and F. J. Dyer. Capital stock $50,000.

Houghton, Mich.—A company is being organized to build an electric railroad between Houghton and Hancock.

Keene, N. H.—The Springfield Electric Railway has been organized. The line will extend from Springfield, Vt., to Charleston, N. H.

Uklah, Cal.—Mendocino County Electric Co., has been incorporated by William V. Lockwood, Philip S. Taylor, Frank Morse, W. A. Hagans, T. A. Templeton. Capital stock $20,000.

Nashville, Tenn.—The Electric Supply Co., has been incorporated by L. G. McDonald, S. T. Carnes and others.

Albany, N. Y.—The Olean, Rock City & Bradford Railway Co., has been incorporated, with a capital stock of $100,000.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued December 15th, 1896.

573,041. Electric Furnace. Martin Schindler, Neuhausen, Switzerland. Filed April 23, 1896.

573,042. Electric Boiling Apparatus. Friedrich W. Schindler-Jenny, Kennelbach, Austria-Hungary. Filed February 27, 1894. Patented in Austria-Hungary August 22, 1891; in Switzerland August 29, 1891; in France September 3, 1891; in Belgium September 4, 1891; in England October 2, 1891, and in Italy December 31, 1891.

573,066. Electric Railway Construction. George Westinghouse, Pittsburg, Pa. Filed June 8, 1896.

573,078. Wattmeter. Thomas Duncan, Fort Wayne, Ind. Filed April 29, 1896.

573,079. Meter for Measuring Electric Currents. Thomas Duncan, Fort Wayne, Ind. Filed May 7, 1896.

573,080. Electric Meter. Thomas Duncan, Fort Wayne, Ind. Filed July 22, 1896.

573,082. Electric Meter. Carl Erben, Berlin, Germany. Filed October 10, 1895. Patented in Germany June 21, 1892; in Austria-Hungary November 6, 1893; in England November 9, 1893; in France November 11, 1893; in Belgium November 13, 1893, and in Switzerland February 21, 1894.

573,088. Electric Sign. Frederick H. Hawkins, New York, N. Y. Filed January 13, 1896.

573,092. Insulator. Fred. M. Locke, Victor, N. Y. Filed August 24, 1896.

573,101. Wall Insulator. James J. O'Neill, Boston, Mass. Filed December 19, 1895.

573,105. Collecting Brush. Edward B. Raymond, Schenectady, N. Y. Filed August 5, 1896.

573,107. Securing Field Magnet Poles. Henry G. Reist, Schenectady, N. Y. Filed August 24, 1896.

573,117. Telephone Circuit Line Signal. Thomas C. Wales, Jr., and Chester H. Arnold, Boston, Mass. Filed July 20, 1896.

573,130. Attaching Field Magnet Poles. Francis O. Blackwell, Schenectady, N. Y. Filed August 24, 1896.

573,162. Electric Arc Lamp. Charles Richter and Richard T. Eschler, Camden, N. J. Filed April 9, 1896.

573,169. Electric Railway. Anson Sprague, San Leandro, Cal. Filed March 30, 1896.

572,176. Electric Cable. Francois Borel, Cortaillod, Switzerland. Filed January 7, 1896.

573,221. Electric Signaling Apparatus. Felix B. Herzog and Schuyler S. Wheeler, New York, N. Y. Filed January 25, 1896.

573,222. Automatic Grounding Device for Electric Conductors. George A. Jewett, Chicago, Ill. Filed December 6, 1895.

573,233. Process of Precipitating Precious Metals from Their Alkali Cyanide Solutions. Max Netto, Almazarron, Spain. Filed March 16, 1896.

573,234. Electric Railway. Andrew C. O'Connor, Lynn, Mass. Filed October 26, 1895.

573,245. Electric Soldering Club. Paul Stotz, Stuttgart, Germany, and Friedrich W. Schindler-Jenny, Kennelbach, Austria-Hungary. Filed January 14, 1895. Patented in England September 8, 1894; in France October 10, 1894; in Sweden October 12, 1894; in Belgium October 15, 1894; in Switzerland October 17, 1894; in Hungary November 9, 1894; in Austria November 23, 1894; in Germany November 28, 1894, and in Italy December 31, 1894.

573,257. Trolley Pole Safety Device. Borre H. Borreson, Minneapolis, Minn. Filed July 26, 1895.

573,294. Telephone Transmitter. Forest A. Ray, Boston, Mass. Filed April 6, 1896.

573,302. Conductor of Electricity and Conduit for Holding Same. Alexander Selkirk, Albany, N. Y. Filed January 30, 1896.

573,323. Armature Jack. William A. Drysdale, Overbrook, Pa. Filed August 22, 1896.

573,344. Switch for Electric Railways. Shadrach A. Mustein, Rincon, N. Mex. Filed June 22, 1896.

573,350. Station Indicator for Railways. Andres Palfy, Budapest, Austria-Hungary. Filed August 3, 1896.

573,355. Apparatus for Purifying and Decolorizing Saccharine or Other Liquids. Marshall Pridham, Philadelphia, Pa. Filed September 12, 1896.

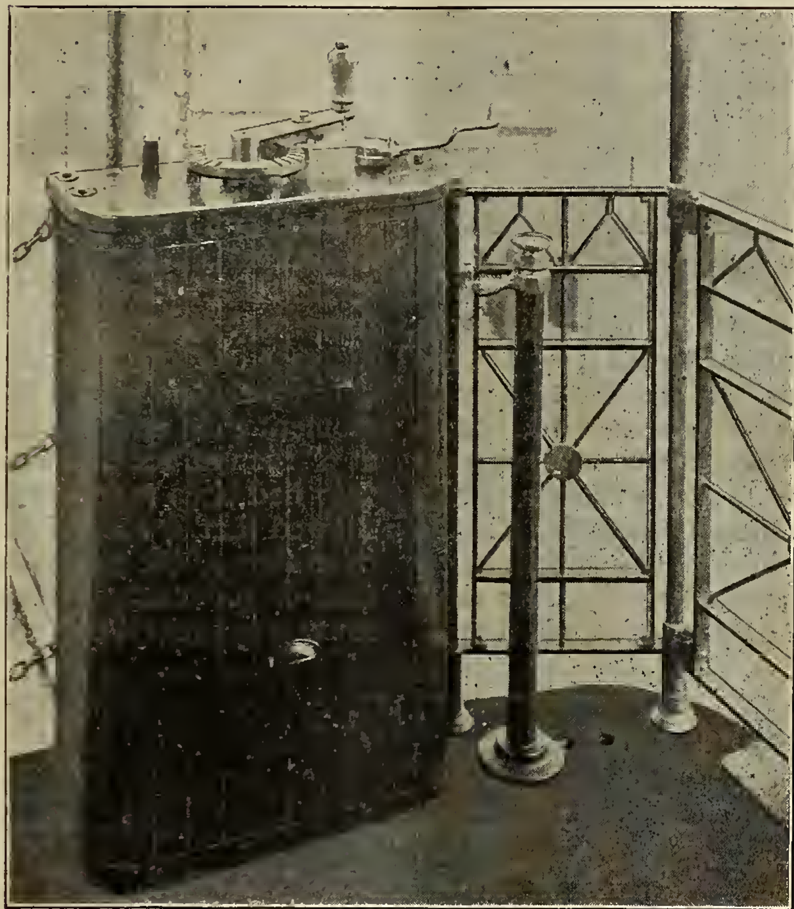
573,356. Telephone Transmitter. Leon W. Pullen, Camden, N. J. Filed November 11, 1895.

573,387. Combination Gas and Electric Fixture. James E. Brown and William M. Brown, Toledo, Ohio. Filed July 20, 1896.

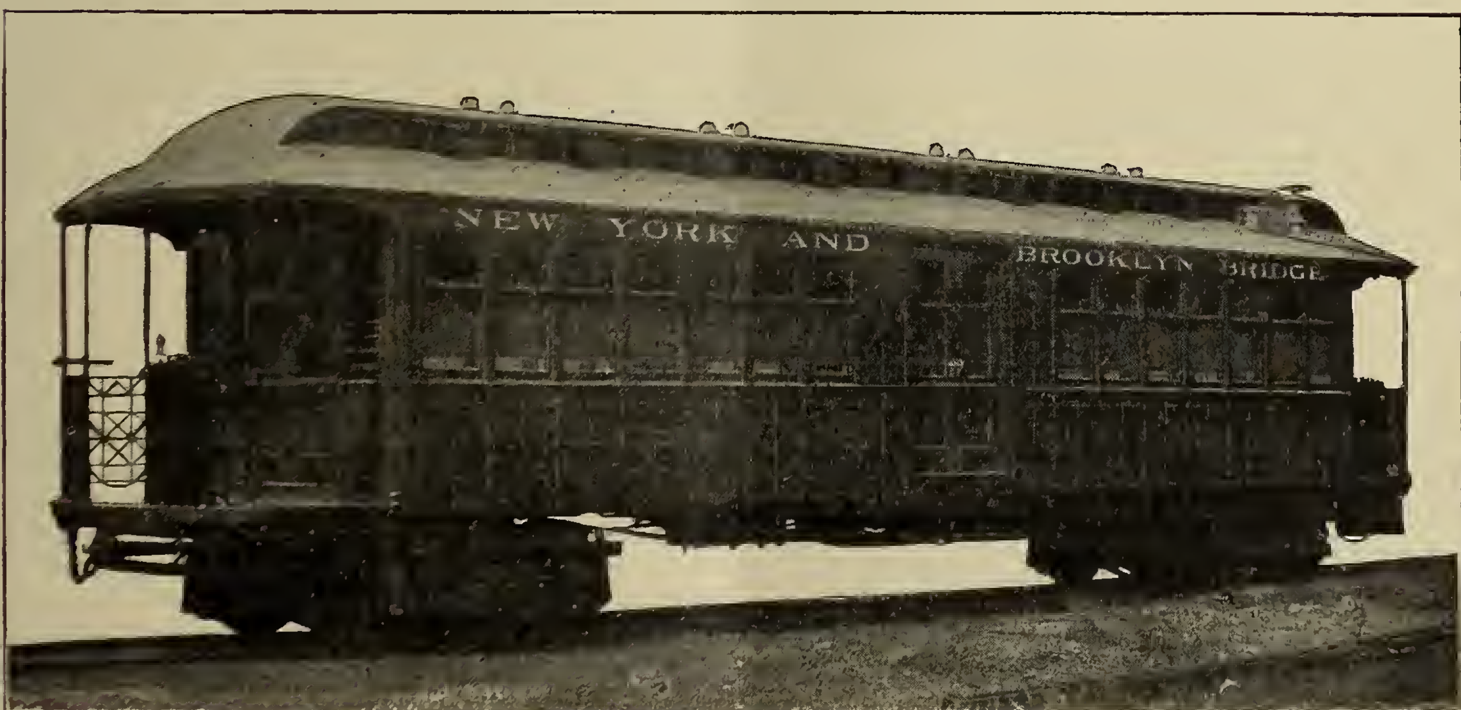
573,398. Electric Arc Light. August C. Dobrick, Chicago, Ill. Filed June 13, 1896.

The Electrical Age.

Vol. XIX., No. 14. NEW YORK, APRIL 3, 1897. Whole No. 516



Controlling Device,



Fully Equipped Car.

THE ELECTRIC EQUIPMENT OF BROOKLYN BRIDGE CARS.

The switching of the Brooklyn Bridge cars by electricity will shortly become an accomplished fact. The cars are being rapidly finished, and as they reach the yards of the Brooklyn Bridge Railroad, will be fitted as fast as possible with the electric apparatus. The twenty car equipments forming the order are now ready in the shops of the General Electric Company, waiting for the cars to reach Brooklyn.

The first car, a handsome piece of work, reached Schenectady from the shops of the Pullman Palace Car Company a few weeks ago, was fitted with the electrical apparatus and is now in Brooklyn. The remainder of the cars will be equipped at their destination.

The electrical equipment of each car consists of four G. E. 50 motors and two K 14 controllers, both especially designed for this work. The motors are completely encased, and are water-tight and dust-tight. The armatures are slotted, each coil lying in its own slot, and the method of winding followed allows of the removal of any coil with very little disturbance to the others. Each motor is provided with a roller, which will come directly over the cable and prevent it from abrading the motor

or injuring it in any way and from being injured itself.

The K 14 controller is the standard K type of controller which will be used in this case. It embodies all the qualities of the K type, and, of course, has the magnetic blow out. Two circuit breakers, a magnetic fuse box and twelve resistances complete the electrical motive equipment.

The only portion of the electrical apparatus which will be apparent to the public will be the controllers, at the extreme edge of the platform, and an upright iron post with a small handle to operate the circuit breakers. Motors, resistances, circuit breakers, etc., will all be out of sight beneath the car. The circuit breakers are closed and opened from the platform, but are so placed that inspection can readily be carried out.

The duties which these motors will be called upon to perform will be to switch the four-car trains from the incoming to the outgoing patforms. When the trains are loaded the motors will push them forward over the tilting sheaves, where the cable will be taken up by the grips on the other three cars of the train. The conditions of the contract between the electrical company and the Brooklyn Bridge trustees require that, in case of any failure on the part of the cable plant, the four motors together shall be powerful enough to propel the fully loaded train weighing 120 tons across the bridge at the speed of the cable, i. e., 11.3 miles per hour. The capacity of the motors is such that they will be able to haul the heaviest bridge trains up a 3.78 per cent. grade, not only for the short thousand feet—the length of that grade on the bridge structure—but the whole length of Manhattan Island if necessary. The trucks of the new cars are from the shops of the McGuire Manufacturing Company, which has recently constructed the trucks of the electric cars used on the Lake Street elevated in Chicago.

The third-rail method of contact will be adopted, and current will be taken by four shoes to each motor car, two on each side. These are suspended from a support set between the journal boxes of each truck, and will be so hung as to give a perfect contact with the third rail.

As soon as the full number of motor cars is equipped and in service the steam locomotives will be taken off. This will not only mean a relief to the passengers on the trains, but an actual source of economy to the bridge itself, the gases from the locomotives proving an actively destructive agent to the ironwork of the terminal stations.

The question of the abandonment of the cable for the complete operation of the bridge trains by electricity is one which will probably be settled in favor of the cable. The uniform speed given to the cars by the cable, and the fact that the cars, while attached to it, are spaced at regular intervals, eliminate from the operation of the trains a personal factor which might tend to accident, while by balancing up grade trains against those running down grade, the consumption of power is reduced to a minimum.

THE INFLUENCE OF HEAT TREATMENT UPON THE MAGNETIC PROPERTIES OF HARDENED STEEL.*

BY DR. K. E. GUTHE.

Steel and iron, when heated to high temperatures, show a decided change in their magnetic properties. The earlier investigations† have shown, that in general the temporary induction in iron and steel rods increases with increase of temperature. G. Wiedemann‡ found that very hard steel rods show at 100° a larger temporary magnetic moment than at 0°, soft rods a larger magnetic moment at 0° than at 100° for the same magnetizing force, after they had been repeatedly heated and cooled. Rowland§ showed that a rise of temperature causes an increase of induction, if the magnetizing force is small, but a diminution of induction if the magnetizing force is large. The same was observed by J. Hopkinson,* who undertook a great number of experiments in this line, especially in order to show the relation between the critical temperature, at which iron ceses to be magnetic, and the recalescence, first discovered by Barrett. According to the former recalescence occurs at the critical temperature. Osmond, who distinguishes three points of recalescence for soft steel, places the critical temperature at the second point of recalescence. Tomlinson's† and Kunz's‡ experiments show also the change in magnetic properties due to a rise of temperature.

After steel has been heated beyond recalescence and is suddenly quenched in cold water, the mechanical hardening is accompanied by a corresponding magnetic hardening, *i. e.*, the permeability decreases and the hysteresis loss increases greatly. This influence of hardening is well known, and was first thoroughly investigated by Ewing.§

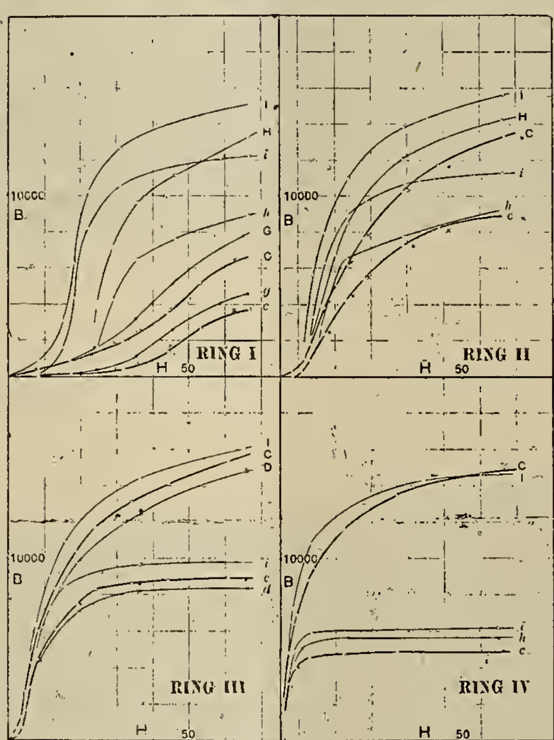


PLATE 4.

*A paper presented at the 114th meeting of the American Institute of Electrical Engineers, New York, March 24th, 1897.

†. Wiedemann's "Electricitæt," 2d ed., III., p. 848–860.

‡. G. Wiedemann. *Pogg. Ann.* 122, 346, 1864.

§. Rowland. *Phil. Mag.* (4), 48, 321, 1874.

*. Hopkinson. *Phil Trans.* 180 A, 442, 1889. *Proc. Roy. Soc.*, 48, 442, 1890.

†. Tomlinson. *Phil. Mag.* (5), 25, 372, 1888.

‡. Program Gymnasium zu Darmstadt, 1893.

§. Ewing. *Phil. Trans.* 547, 1885, or Ewing, "Magnetic Induction," etc., p. 82.

Very little is known about the influence of heat treatment on such hardened steel. Barus and Strouhal,* in an exhaustive paper, show the influence of tempering on the retentivity of steel magnets, and are the originators of the well-known method of seasoning magnets by subjecting them for several hours to a temperature of 100°, which method has recently been used very successfully by B. O. Pierce. Their results, as far as they have a bearing on the present research, are, (1) that the magnetic moment of a hardened steel magnet is smaller after reheating to about 100° than it was before, and that on heating to still higher temperatures it increases again: (2) that the length of time during which the bars have been at the high temperature is of some influence, especially for the lower temperatures. The present work was undertaken with a view of following the annealing process step by step, and obtaining the relations between the magnetizing force, maximum induction, remanence and coercive force for each of these steps. The results are also interesting from a theoretical point of view, since they show a decided difference in the rate of change of the magnetic properties for the different temperatures.

Description of the Method.—The rings were all of the same form, *i. e.*, hoops with an average of 12.6 cm. and a thickness of 8 mm. The diameters were measured by vernier calipers and the cross-section was found by dividing the volume, which was determined by the loss of weight in water, by the average circumference. New measurements were taken every time after the rings had been subjected to a temperature higher than 600°. They were wound with bicycle tape, and on this the primary coil. Before each experiment the insulation was carefully tested. Rowland's ballistic method was employed. Instead of the usual way of finding the constant of the galvanometer by means of an earth coil, I charged and discharged a standard condenser through the galvanometer (see Carhart and Patterson's "Electrical Measurements"). The equations used will then be

$$B = \frac{d_2\, C\, E\, r}{c\, n_2}\,\frac{100}{A}$$

where

B = the increase in induction,

d_2 = the deflection due to the change of the magnetic flux through one square centimetre of the ring,

C = the capacity of the standard condenser expressed in microfarads (= .2 microf.),

E = the $E.\ M.\ F.$ of the Carhart-Clark cell in volts,

r = the total resistance of the secondary circuit,

c = the deflection obtained by the discharge of the condenser,

n_2 = the number of secondary turns around the ring, which was equal to 30 in every case,

and

A = the cross-section of the ring.

$$H \frac{4\,\pi\, n_1}{10\, L} I$$

where

H = the magnetizing force,

n_1 = the number of primary turns on the ring,

I = the magnetizing current expressed in amperes,

L = the average circumference.

The deflection due to the discharge of the condenser was taken on open circuit. This produces an error in the constant. An independent experiment showed that the value obtained is 1.50 per cent. too large. In order to obtain the absolute values for B in the following tables, the data should be multiplied by .985. In order to eliminate the error due to the creeping up of the induction, the steps taken were nearly as possible the same for the same ring at different stages of the treatment. I believe the total errors of observation to lie within .5 per cent.. The experiments at each step for each ring consisted in the determination of the hysteresis curves for a number (8-10) of different magnetizing forces, the largest in every case being between 60 and 65. In the final results I give the hysteresis curves for the largest values of H only. The magnetizing curves were taken, but they are not given under the following results, since, as Hopkinson has shown, this curve for virgin steel differs appreciably from one taken with a ring previously magnetized. It was thought to be of more importance to represent the curves for B_m and B_r as functions of the maximum magnetizing force. (See Plate 4.) Moreover, it was possible to show the influence of the reheating upon Houston and Kennelly's law,† *i. e.*, that for small magnetizing forces the remanence (B_r) is a linear function of the maximum induction (B_m). These two values, B_m and B_r, are plotted on Plate 5, and these curves are of great interest, showing the range through which this law holds good in the different stages of the heating process, and what variations in the constants are produced by the tempering.

(To be continued).

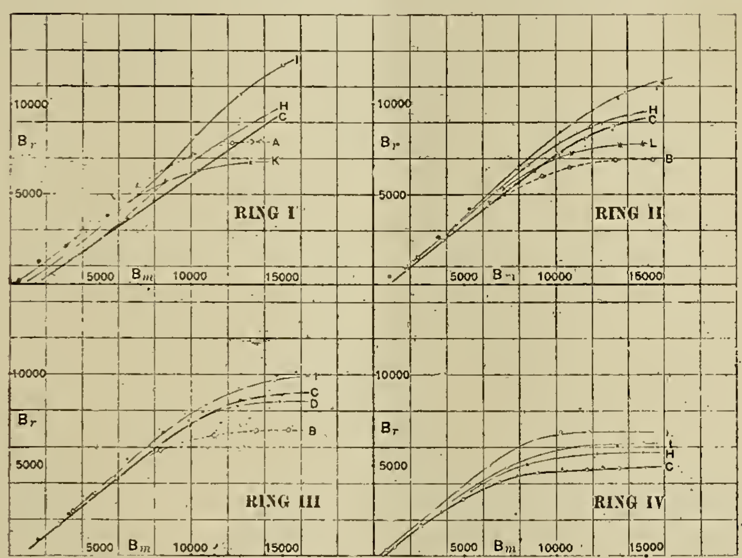


Plate 5.

(Q.)—AMPERE'S THEORY.

New York, March 13, 1897.

To the Editor.

Dear Sir: I am a member of the American School of Electricity, but missed a point at one of the lectures in reference to Ampere's Theory.

Do the currents in each molecule of iron circulate perpetually, or cease when the iron is hot or cold, magnetized or demagnetized?

M. N.

(A.)—They circulate when the iron is cold and when it is magnetized or demagnetized. When hot the molecules lose this property of polarity, but regain it upon cooling.

*. "U. S. Geological Survey," No. 14, 1885.

TRACK AND TRACK JOINTS: CONSTRUCTION, MAINTENANCE AND BONDING.

M. K. BOWEN.*

(Continued from page 202.)

Fig. 6 shows a rail taken from State street track after eight years' wear, during which time 8,000,000 car-wheels passed over it.

Fig. 7 shows a rail when taken out after eleven years' wear. The rail should have been taken out three years previous, but owing to impossibility of getting rails at the time and the World's Fair coming at that time, the track was not rebuilt. The true rate of wear cannot be found, as the flange of the wheel had begun to run on the flange of the rail long before it was taken out. The dotted lines show an interesting state of affairs. This section shows the wear due almost entirely to wagon traffic.

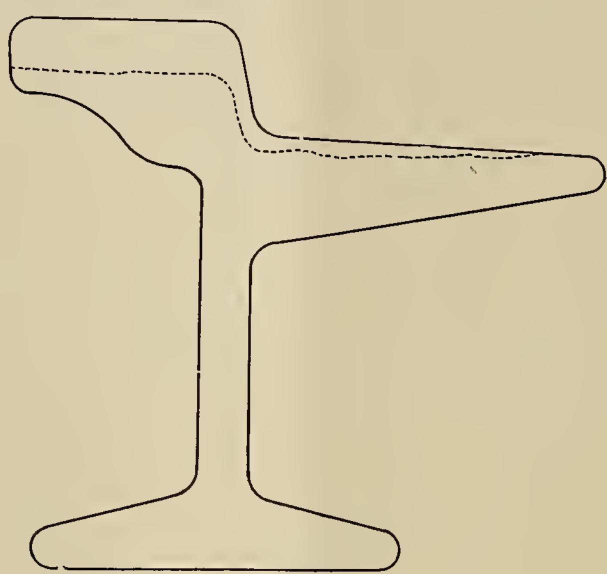


Fig. 6.

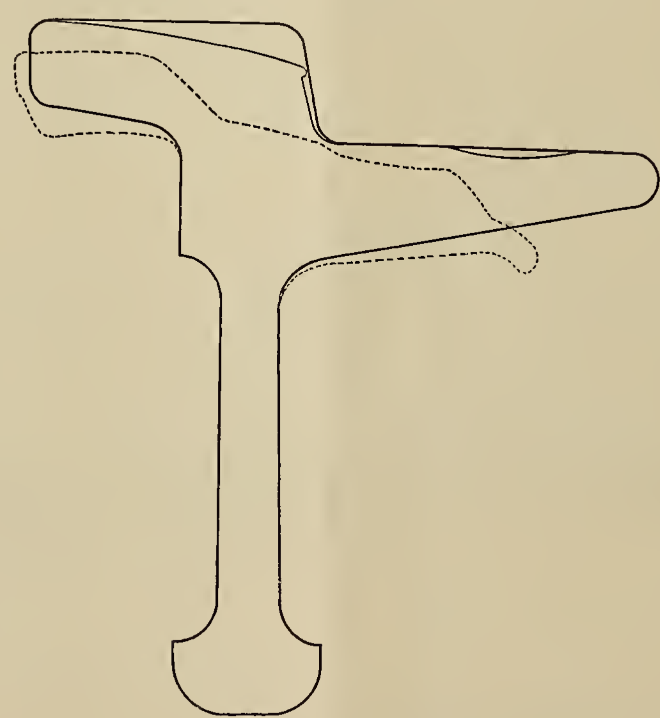


Fig. 7.

Fig. 8 shows the rail used at the present time in our 7-inch construction with chairs or tie plates. The rail weighs 83 pounds and has a head 1 3-16-inch high, bevelled as described.

Fig. 9 shows the rail used at the present time in our 9-inch electric construction without chairs or tie plates. The rail weighs 90 pounds and also has a head 1 3-16 inches high, bevelled as described.

The question concerning the composition of the rails is one to be considered here also. How does the composition affect the life of the rail? The number of starts and stops made by cars on electric railways are enormous, as compared with those on a steam road. The result is the wheels slide, sometimes spin, and this together with the sand and dirt on the track is a cause of great wear on both the wheels and rails. This wear, together with that due to other causes, might be greatly reduced by proper composition of metal.

I give below a table gathered from different sources showing the composition of metal advocated by experts to-day:

	A	B	C	D
Carbon	.46- .55	.55- .60	.50	.40
Manganese ..	.80-1.00	.80-1.00	.75- .95	.01
Phosphorus ..	.06 not over	.06 not over	.09	.11
Silicon	.15- .20	.15- .20	.10	
Sulphur	.07 not over	.05 not over	.07	.06

Rail.	Carbon.	Phosphorus.	Silicon.
70-lb. Tee	.43-.51	.085	.10
75-lb. Tee	.45-.53	.085	.10
80-lb. Tee	.48-.56	.085	.10
90-lb. Tee	.55-.63	.085	.10
100-lb. Tee	.62-.70	.085	.10

It would seem that the harder a rail becomes through its composition and the process of rolling, the longer it would wear. As regards this, Mr. Moxham, of the Johnson Company, says: There are two schools—First, those who advocate a low hardened and ductile material

as being of the greater wear. Second, those who advocate the geatest possible hardness, regardless of brittleness. For many years, without taking positive grounds, I have leaned to the former class, but the experiments so far made have demonstrated to me that neither class is correct—that the correct solution lies between the two.

in temperature for which Chicago is noted. Seventeen thousand joints were put in in 1895, and of those only 154 joints were lost. The joint in comparative tests has been shown to be far stronger than the rail itself, and such breakages as have occurred were due to a flaw in the metal. The metal cast around the joint has eight times the cross-section area that the rail has.

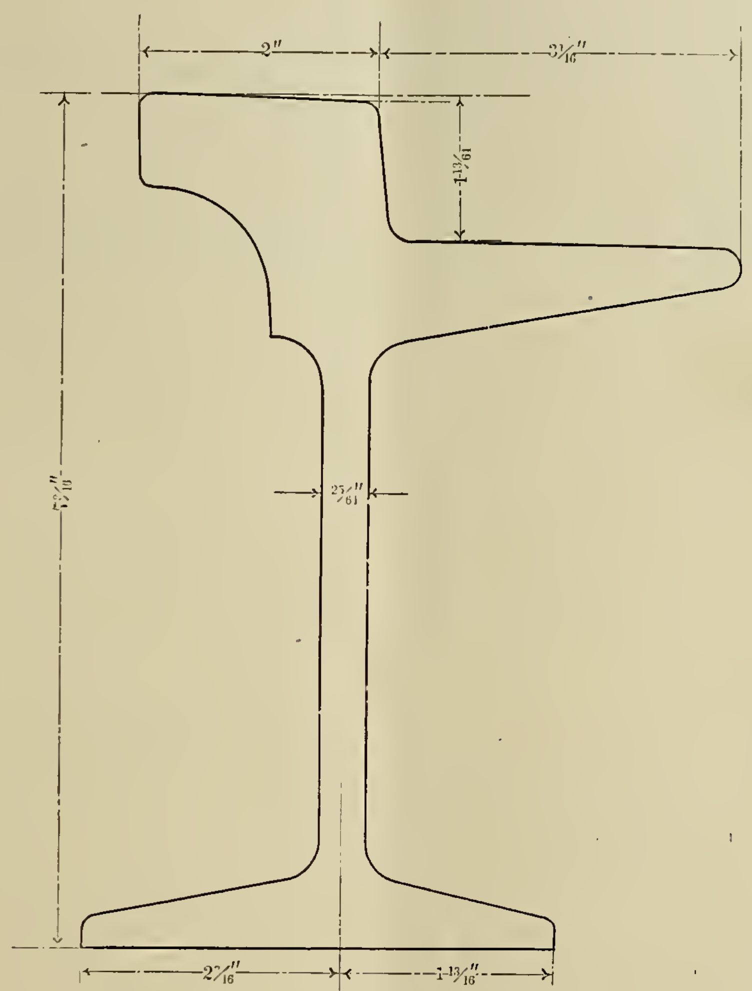


Fig. 8.

I come now to what has been heretofore the weakest part of track construction, namely, joints. Once weakened they rapidly grow worse, and not only are the rails worn at such joints, but the rate of wear of the car equipment is greatly increased. Were it only possible to get rails in continuous lengths, just as one gets trolley wire, the railway manager would be happy, but, as it is, we must do our best to overcome the difficulty found in making rail joints solid and rigid to withstand the severe strains which come upon them. What we want is some method of keeping the rails from

Hence, considering steel as four times as strong as cast iron, the joint is twice as strong as the rail. It has been found in some cases where this joint was used at crossings with other tracks, the tracks were apt to be pulled out of shape through the changes of temperature. To overcome this the joint nearest the crossing should be anchored in a substantial manner. The method of making the joint is as follows: The rails at the joint are scraped and brightened, a cast iron mould is placed around the joint, making a tight fit, into this the molten iron, 25 per cent. scrap, 25 per cent. soft, and 50 per

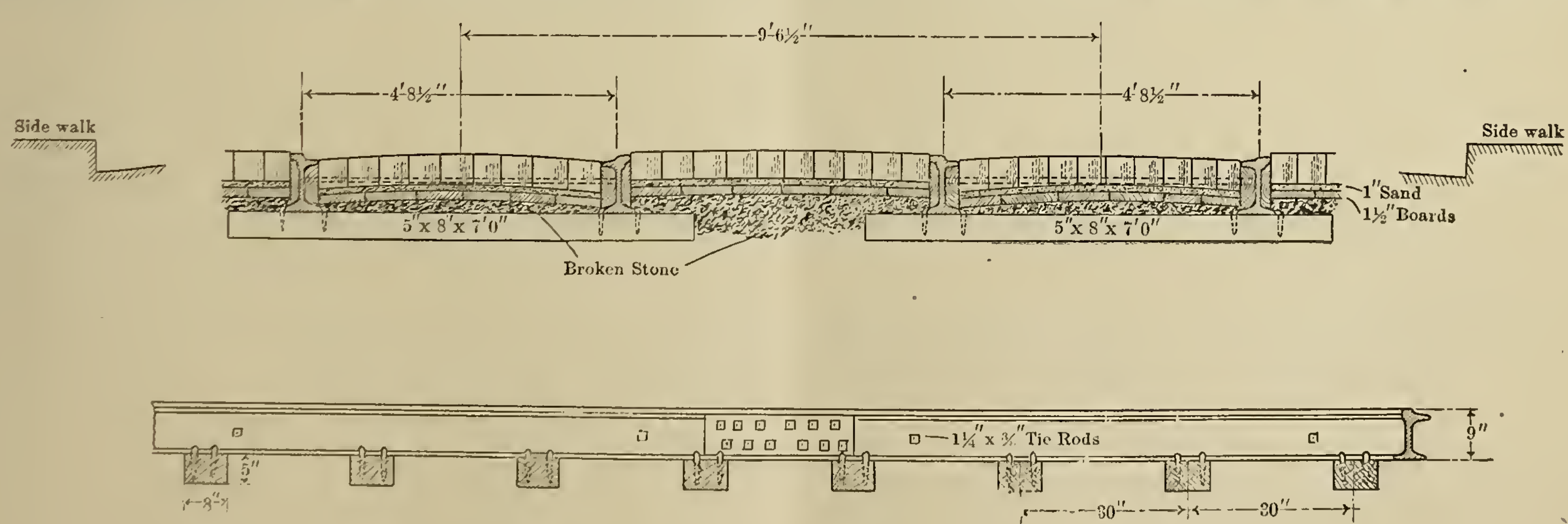


Fig. 10.

pulling apart at the joints, due to contraction and spreading outward at joints, and the shape, due to the outward pressure, of the car-wheels, and from bending down at the joints, due to the pounding and weight of the cars. The joint I have used for the past year is a cast, welded joint. This has been found to give perfect satisfaction as a joint; it is strong and substantial, as has been proven by its holding under the extreme changes

cent. hard silicon pig, is poured; the metal in contact with the mould begins to cool and forms a crust while the interior remains molten. This crust continues to cool and at the same time contracts, forcing the molten metal strongly towards the centre, which makes a solid and rigid joint. The top, or bearing part of the ball of the rail, is afterwards filed off perfectly level so that it is very difficult to detect a joint by riding over it or

looking for it. Upon breaking a joint which has been well cast three spots will usually be found where amalgamation has taken place between the rail and cast portion; one on each side of the web and the other on the bottom. These spots are from 1 1-2 inches to 2 inches in diameter. There has been some discussion as to its being a bond for carrying electric current. I cannot recommend it with certainty, as there are occasional joints which I have taken off where no amalgamation has taken place whatsoever, thus destroying the effect as a bond of all joints in that line of track. To overcome this difficulty I have adopted the plan of bonding all joints. However, future experiments and care in the casting of joints may develop their efficiency as a bond.

I give below an outline of specifications for track construction, used by the Chicago City Railway Company, to be three feet from the ends of the rail; the rails on both sides to be filled with wooden or vitrified brick filling between the paving blocks and the web.

(To Be Continued.)

The Making of Electrozone.—Dr. William H. Ford, president of the Board of Health, in speaking of the action of the Building Commissioners in prohibiting the manufacture of electrozone in the basement of the City Hall, said that the commissioners were led to take that action because some of the fluid, which had been left in a tank through the mistake of an employe, accidentally leaked out and ran over the electrical wires, eating away the insulation, and, when they made an investigation, they learned that some of the electric power was utilized in making the disinfectant.

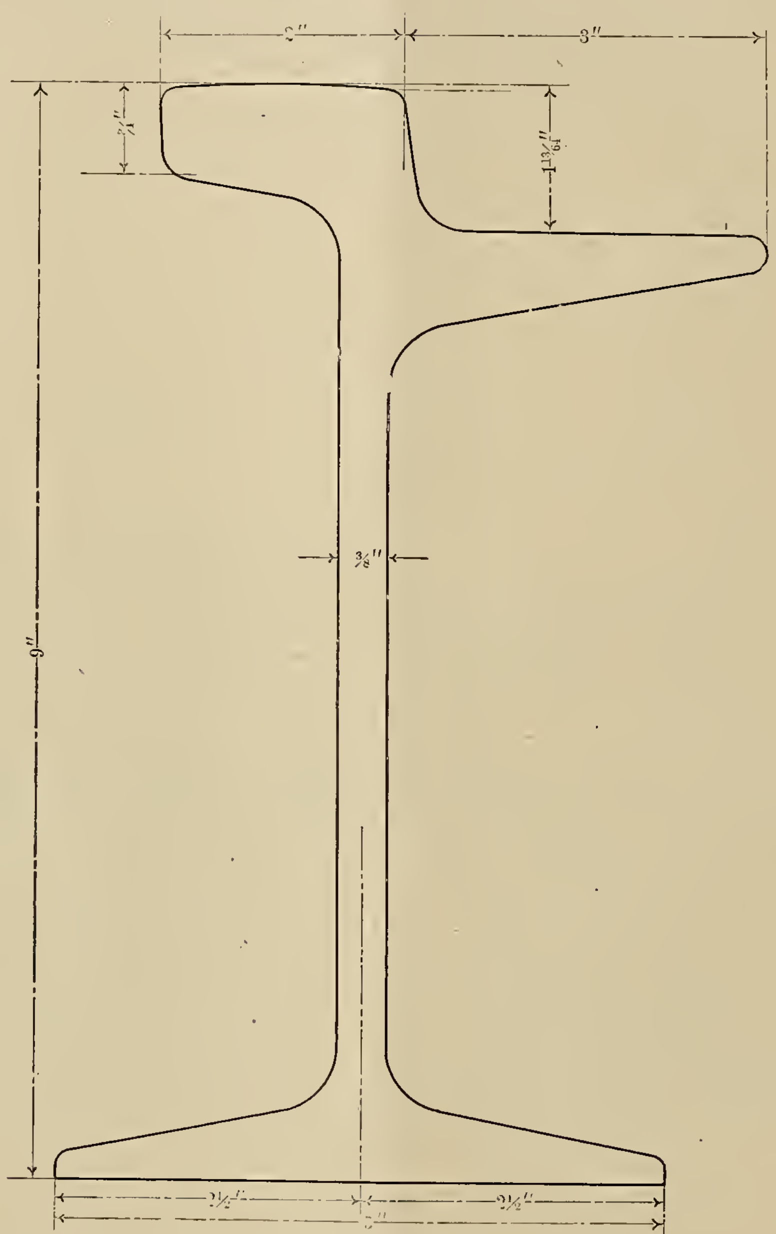


Fig. 9.

knowing that it will not fill all conditions, but will serve as a suggestion for all cases. Fig. 10 shows a section of same, except as regards joints.

Excavation.—Excavate to a depth of nine inches below the established grade of the street, taking out all dirt for a width of 18 feet; then excavate for each tie to a depth of five inches, leaving the earth between the ties in places.

Ties.—The ties, which should be of good sawed white oak, 5 inches by 8 inches by 7 inches, free from sap, are laid in their proper places, 30 inch centers, directly upon the ground, and thoroughly tamped with medium broken stone.

Rails.—The rails to be used are nine inch girder rails, fives inches base, sixty feet long; the head to be bevelled for two-thirds its width to conform to the bevel of the car-wheel (see Fig. 8). These are laid on the ties and fastened with 1-2 inch by 1-2 inch by 4 1-2 inch H. H. Spikes—eight spikes to a tie. Double nut tie rods, 1 1-4 inch by 3-8 inch, are to be used six feet apart; the first and last

"We can manufacture electrozone there ourselves at a very light cost," he said, "and as it is an absolute necessity, it would save the city thousands of dollars were we allowed to continue. The disinfectant is very necessary to the health of the city during the warm weather, the only time we manufacture it. It is in liquid form, and is placed in the gutters, inlets and other places from which bad and dangerous odors emanate and from which many disease germs come. It neutralizes the odors and destroys the germs. If we are compelled to purchase it from manufacturers it will cost us fully double what it is costing us now. I think it is probable that the order will be rescinded."

A very handsome calendar has been received by us from the Snow Steam Pump Works, of Buffalo, N. Y. It is ornamented with a fine half-tone engraving of the gigantic monarch Vertical Triple Expansion Pumping Engine, erected by them.

The Electrical Age.

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CONTENTS.

ELECTRIC CARS FOR RAPID TRANSIT IN NEW YORK CITY.

After considerable discussion and political sand-bagging, Mayor Strong has been led to sign the bill for rapid transit in this city. In all probability a tunnel will be cut through which will reach from the upper end of the city to the lower, as far South as the Battery. The experience of those who have ever travelled in tunnels, even when freely admitting light and air, is such that if steam cars are used in this new and problematical tunnel the cars will have to be sealed in order to insure the lives of the passengers, or at least to protect them from the noxious sulphurous gases and smoke-laden air. It is highly likely in the face of these facts that the people of New York will require some little comfort in their enjoyment of rapid transit; and that can only be obtained by the protection of this long subterranean passage from foul air by the use of electric cars. In all probability an open conduit electric road would operate to perfection under these circumstances. The tunnel under the Thames River, in London, is protected from an unclean atmosphere by the fact that no steam cars are used within it. We have not the least doubt, therefore, that the intelligence of those who have framed the bill will be equal to the occasion as far as its practical fulfillment is concerned and will doubtless take means to prevent the acceptation of any plan that will possess disagreeable features to the public.

ACETYLENE IN PARIS.

The Prefect of Police at Paris has recently become impressed with the fact that acetylene explosions are likely to be injurious to those unfortunate enough to be present when the accident occurs. Many have taken place in laboratories equipped for its manufacture. There is no doubt about its usefulness as a new illuminant, but there is likewise no doubt as to its detonating and highly explosive properties if carelessly, and sometimes if carefully handled. The restrictions and regulations have assumed this form, "Manufactories of carbide of calcium and acetylene compressed to more than one and a half atmosphere, or liquefied, are to be placed in the first class of dangerous buildings. Manufactories of acetylene gas not compressed or compressed to less than one and a half atmospheres, if for public use, are to be in the first class, whilst if for private use, in the third class." It thus seems that a certain classification has been made which gives to the prefecture of police a means of judging at once of the dangers that may possibly arise within such structures. In the early history of the manufacture of illuminating gas suffocations and explosions were of frequent occurrence; care, however, has inculcated habits regarding its use which have ultimately become second nature; possibly a closer acquaintance, if not a longer one, with acetylene may mitigate dangers arising from its use.

A Great Motor.—At the Chaquette Power Company's factory, Bridgeport, the inventor, Mr. Chaquette, has nearly completed a remarkable invention by which he claims that the power given by a 140 horse-power engine can be increased to 2,500 horse-power. The invention is in the shape of a big wheel, 83 feet in diameter, revolving horizontally on an iron hub. The rim of the wheel has, at intervals, small supporting wheels in sets of three. The two outside wheels strike and pass over, at short intervals, "rocker bars," the tilting of which, first one end and then the other, drives the pistons in air compressors below. There are 200 of these compressors. These cylinders are 12 and 16 inches in diameter, and all have a stroke of 12 inches. An air tank carrying a working pressure of 100 pounds to the square inch is provided, and the air is led by pipes to this tank from the compressors. The large wheel is revolved at the rate of 10 revolutions per minute by the steam engines, and the solid four-and-a-half-ton wheel in the periphery of the large wheel, continually engaging the rocker arms, does the rest. The machine thus described may in practice prove to be an economical air compressor, capable of converting the force transmitted by two 70 horse-power engines into force in compressed air when the minimum of the claims of the inventor can be substantiated.

Another Injunction Granted.—Judge Nash has granted the Advertising Index Company another injunction restraining the Bell Telephone Company from interfering with the former's wall books. The first was set aside by the defendant on a technicality.

The two corporations are at odds over a publication issued by the advertising company, which contains the telephone numbers of the customers of the Bell Telephone Company, besides a list of fire alarm boxes and a quantity of advertising matter. This is hung up on the walls of offices in which there is a telephone and answers every purpose of the regular telephone book. The advertising company claims that the telephone people have been tearing these down and don't propose to have it continued. The trouble bids fair to be settled in the courts, in the meantime the Advertising Index Company's wall books will hang where they have been placed.

ARC LIGHTING.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

When a motor is to be installed certain precautions must be observed in order that no injury from fire can result and no danger from shock exist.

The fire underwriters of every large city impose limitations upon contractors and prevent them from doing careless work. It is usual to mount the motor upon a fireproof foundation and have a large pan underneath to catch the oil drippings. A zinc pan is frequently used for this purpose, the motor being mounted in the centre of it. The starting box must be of slate and have under it a large sheet of asbestos paper. The fuse blocks, devices used for the protection of a line, must be covered to eradicate the dangers of fire from the vaporized metal.

In total the installation of either motor or dynamo must be based upon the fact that the risks from shock and fire are to be entirely removed. A low voltage motor or dynamo does not introduce much danger from mere shock; in this respect, up to about 400 volts the person in charge is secure, but the chances of fire always exist.

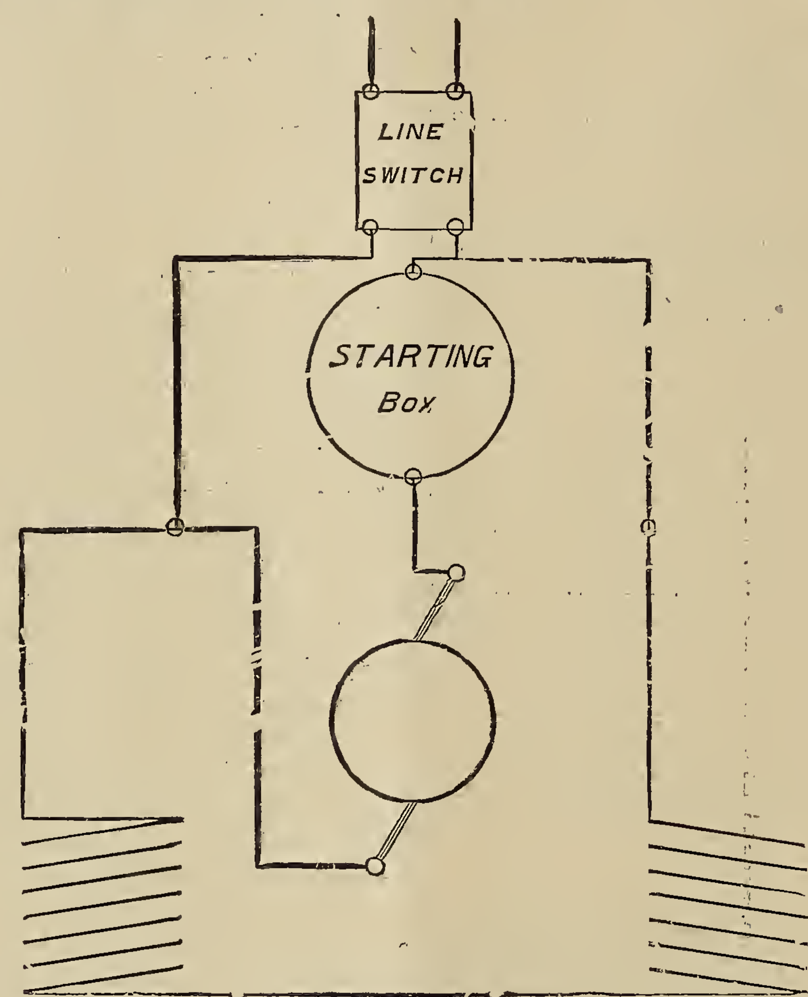
A loose hanging connection, a short circuit on the line, a bad ground, etc., may bring about this danger unless regular tests are made to keep the line clear and dynamo insulated. A lightning arrester is a very necessary adjunct to a plant having an outside line. Frequently a station is destroyed by lightning according to report. This may not be true, although lightning is in many cases the original cause. Lightning by striking a line, or dynamo through the line, usally sparks across every available gap.

An arc is thus started and continued by the generator itself. It is thus very likely that in many instances the burning is done by the dynamo current, although the original cause—lightning—has long since disappeared. Protectors in many cases fail to protect because there is a certain element in lightning arresters that must be improved, and a peculiar oscillatory nature to the discharge that must be better understood in its many variations before they can be used with certainty in every case.

Both dynamo and motor are protected from an overflow of current by means of a safety fuse or cut-out. This is simply a piece of lead wire inserted in the circuit and of such a size that a flow exceeding the regular amount will melt it and open the line. The danger being over it is then replaced by another piece. Good insulation to either dynamo and motor, good safety devices, in the shape of either cut-outs or lightning arresters and a drip pan to catch the oil, comprises the essential elements of a good installation.

Arc Lighting Machines.—Arc lighting machinery differs from incandescent in one or two respects.

As a rule arc light machinery is of higher pressure; it is also series-wound and therefore regulated differently, and in addition the line is a simple series circuit. The high tension or direct current dynamos, as they are often called, requre an attendant, only valuable if experienced and ready to grasp a situation at times filled with deadly danger.



Motor Connections.

The case of high tension arc machinery is not the pleasantest occupation in the world. There is a series dynamo, the armature of field winding forming one continuous circuit in addition to a long outside line.

Pressure of Arc Lamps.—The string of arc lamps connected to the outside line each require 50 volts. The pressure developed by a machine is automatically regulated according to the number of lamps in circuit. A 50-light machine would generate $50 \times 50 = 2{,}500$ volts, if fully loaded, yet it will give anything less than that up to 50 volts if so required.

Regulation.—To control the voltage of any dynamo it is necessary to vary either the

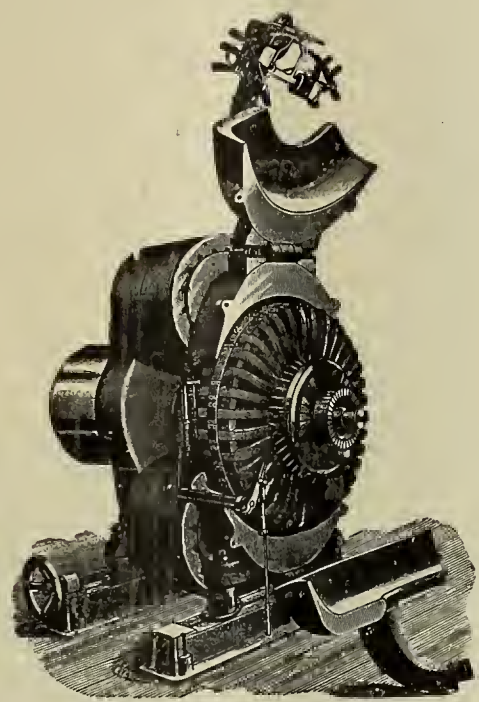
speed,
armature turns, or
field strength.

In practice the speed cannot be changed, as the engine runs at a fixed number of revolutions per minute. The field strength may be varied, or the armature controlled so that its full pressure is not collected at the brushes. The two methods employed, therefore, may be defined under the following headings:

Regulation of field.
Regulation of armature.

By shunting the current of the field on and off automatically, will supply more or less lines of force to the armature.

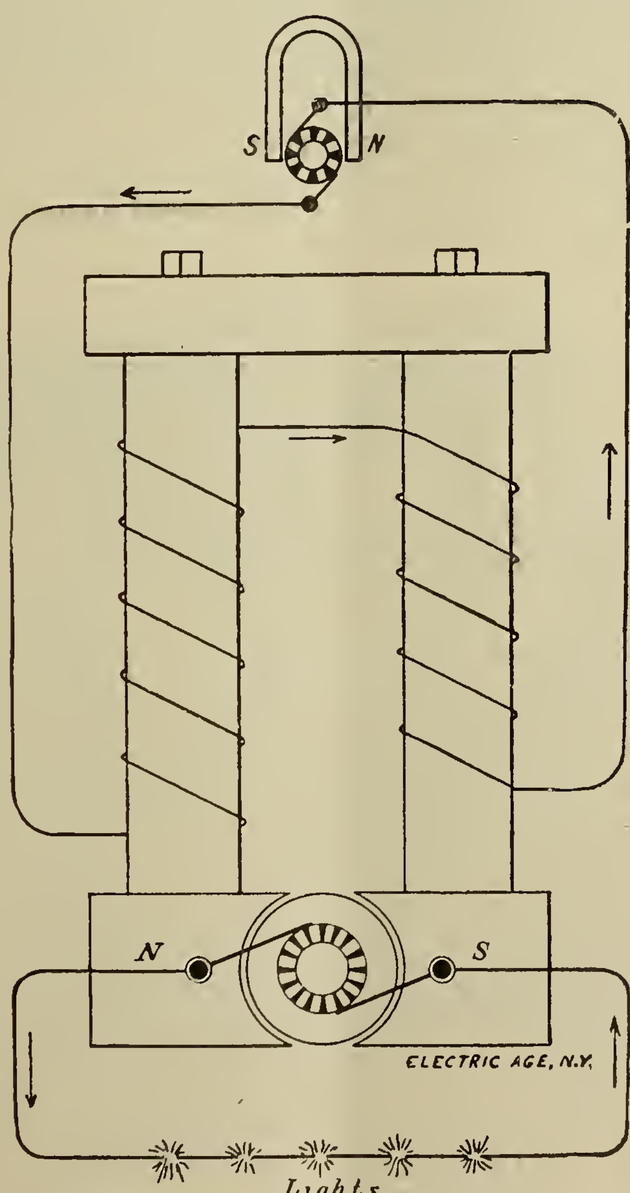
The object of all arc light high tension systems is to preserve a constant current of about 10 amperes and regulate the pressure to the number of lamps used to the extent of just 50 volts apiece. In incandescent dynamos the pressure is kept constant and the current varied to suit the number of lamps.



High Tension Arc Machine.

An electromagnet may do this governed by the outside line; when the current is too strong, the pressure is reduced by decreasing the field and the current diminishes likewise; the converse is also true.

The regulation of each is, in one case, with reference solely to the current; in the other, to the pressure. Therefore shunt wound or incandescent dynamos and series-wound or arc light dynamos are strikingly different in this respect. Dynamos that supply incandescent lights are used for arc lighting also. They obtain their current in shunt from the main current, and are treated



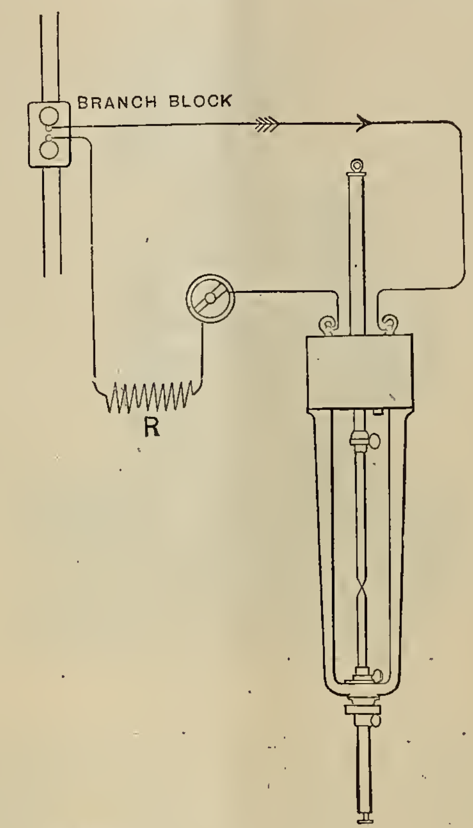
Arrangement of Lights in Series Arc System.

We are now prepared to enter into a general classification of all continuous current dynamos, namely:

Constant current and
Constant potential machines.

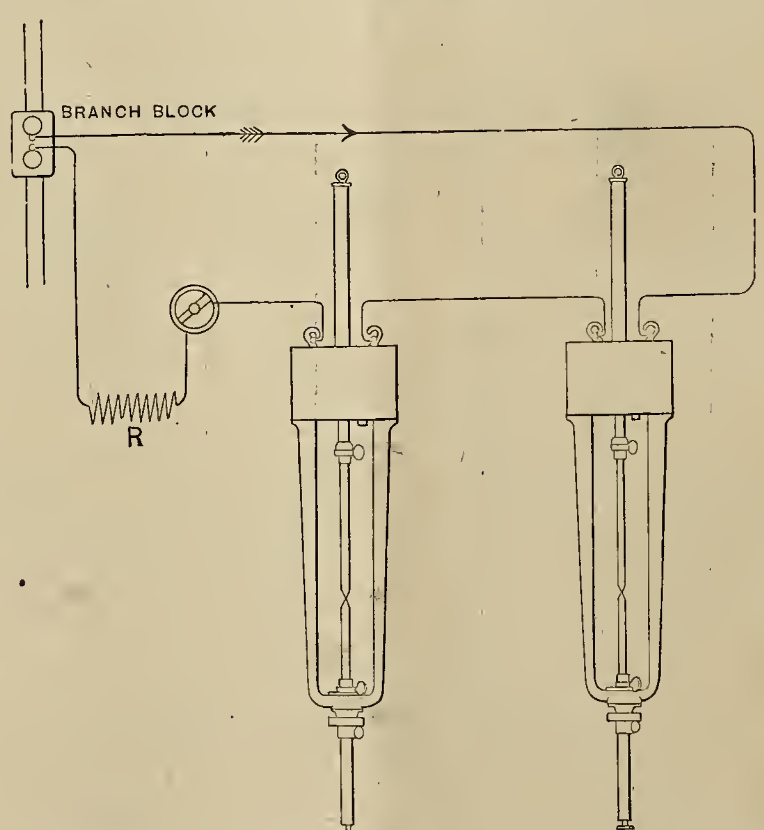
like large incandescent lamps in consequence. For long distance lighting, or the illumination of straggling towns, high tension systems are cheapest.

The regulation of arc systems by means of a special device affecting the armature are most popular. By shifting the brushes on a commutator, the pressure may be varied from nothing to its highest value. If this



Low Tension Arc Lighting on 110 Volts.

change in volts is in exact correspondence with the load or number of lamps, then the purpose of automatic regulation is fulfilled. This is also done by means of an electromagnet in series with the line. When the load is lessened by lamps being removed the pressure, acting through a decreased resistance, increases the current momentarily; this strengthens the magnet, and it pulls



Connections of Two Arc Lamps on 110-Volt Circuit.

the brushes over to a point of lower pressure. These positions of the brushes and volts required for lamps must correspond. The brushes must not move too far or too little, but must be adjusted to touch at the required point of the commutator.

This is practically equivalent to changing the turns on the armature. Therefore, it is seen that the methods of arc light regulation depend upon either a change in field or in effective turns.

Northboro, Mass.—Cutting, Bardwell & Co., are erecting new electric power house, and are making good progress on same.

Gaffney, S. C.—The Fries Manufacturing and Power Co., will develop 2,000 horse power on the Yadkin river and transmit it electrically.

Martin, Tenn.—J. E. Kennedy, Mayor, may be addressed for information concerning construction of electric light plant.

Bridgewater, Mass.—The Brockton, Bridgewater & Tauton Street Railway Co., will build new power station.

Chapel Hill, N. C.—An electric railway will probably be constructed between this city and Durham.

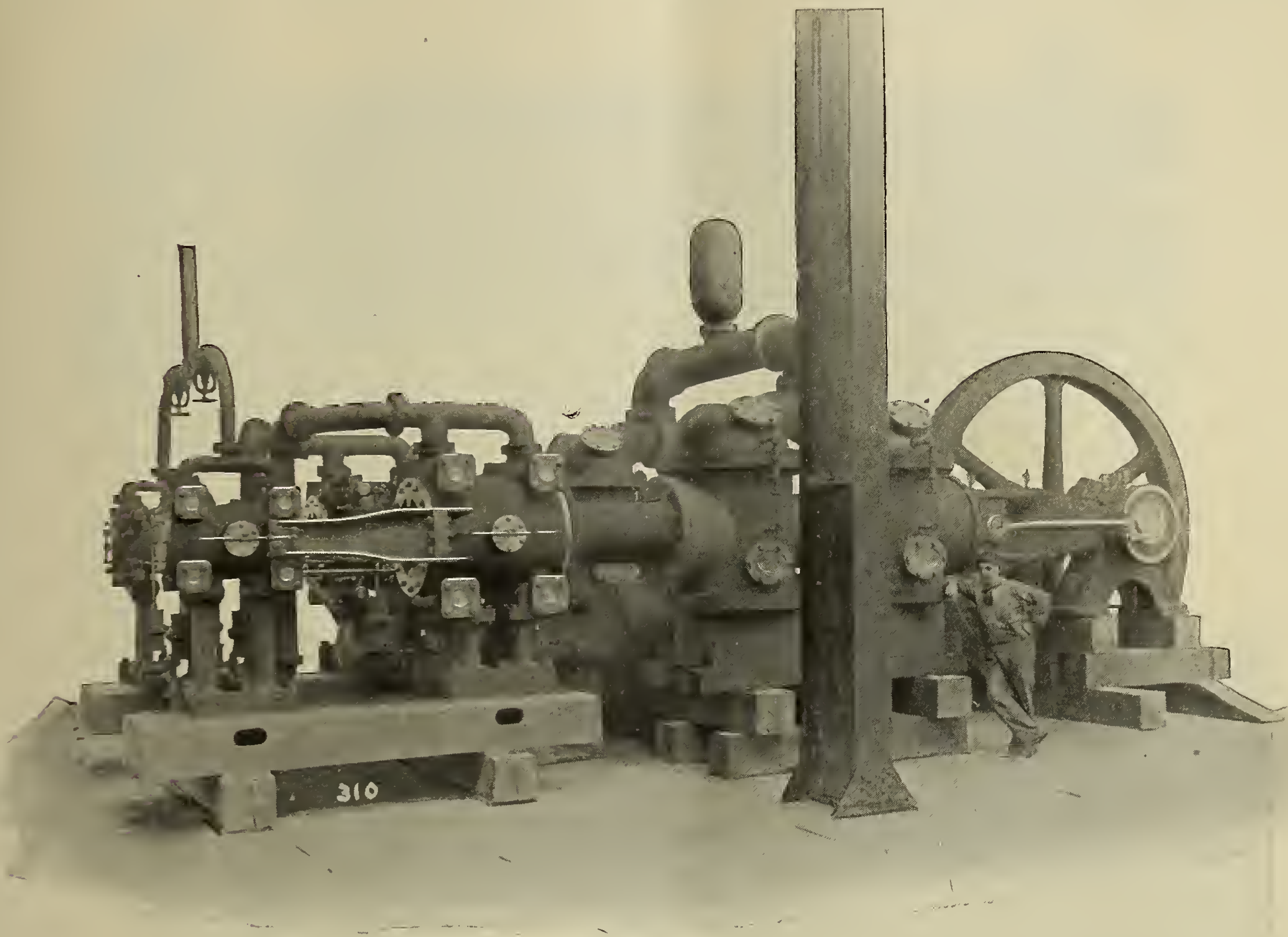
Detroit, Mich.—A 60-mile trolley road will be built between Detroit and Port Huron.

Westmoreland, Kans.—The Missouri Telephone Co., will extend their line to Havensville.

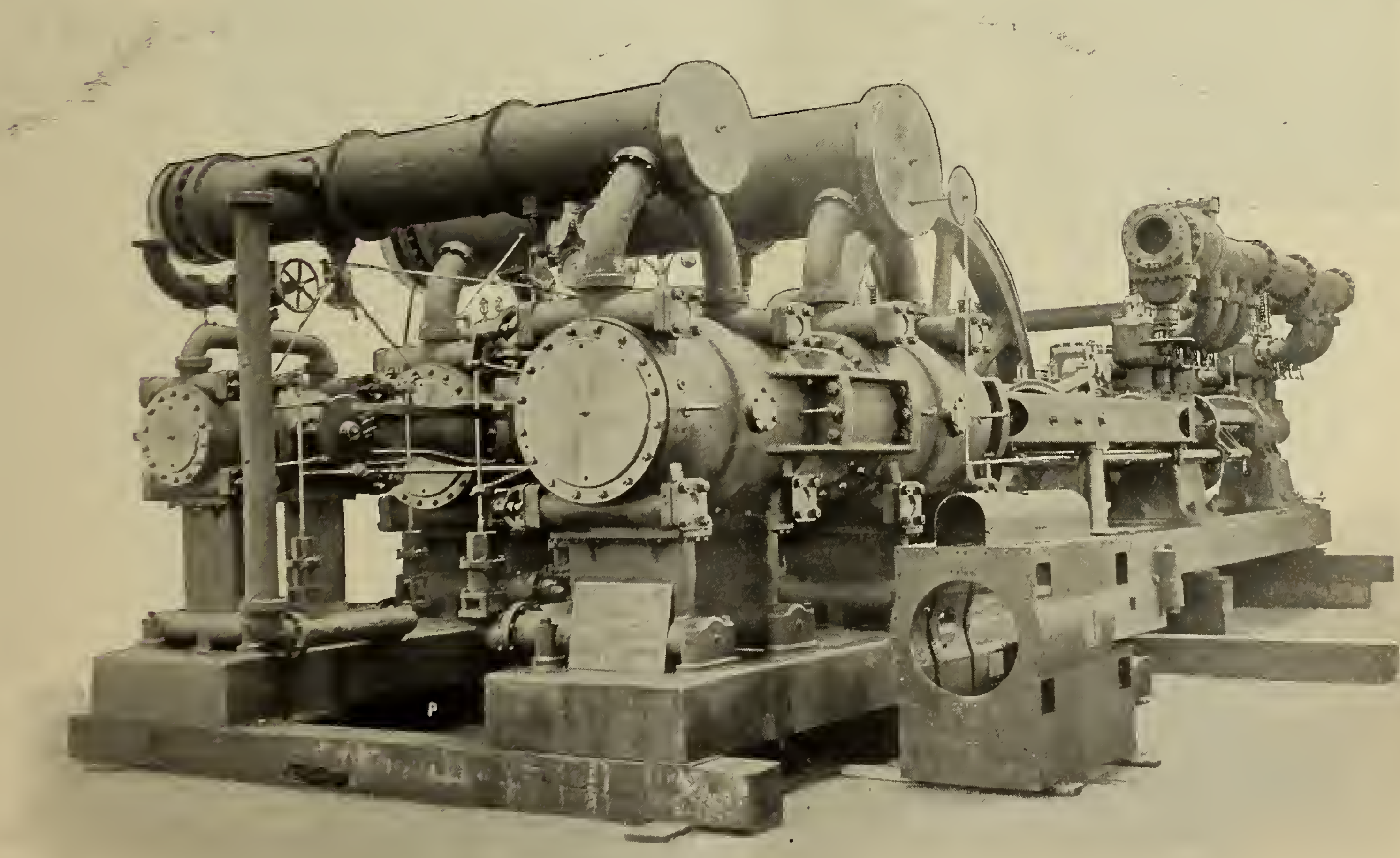
Worcester, Mass.—An electric railway is contemplated from Marlboro through Southboro and Fayville to South Framingham. Arrangements are practically completed for beginning work on the Worcester and Marlboro Street Railway.

SNOW STEAM PUMPS.

It is many and many a century since the old-fashioned method of lowering a bucket into a well has been dispensed with—at least for obtaining great quantities of water.



Snow Duplex Steam Pumps.



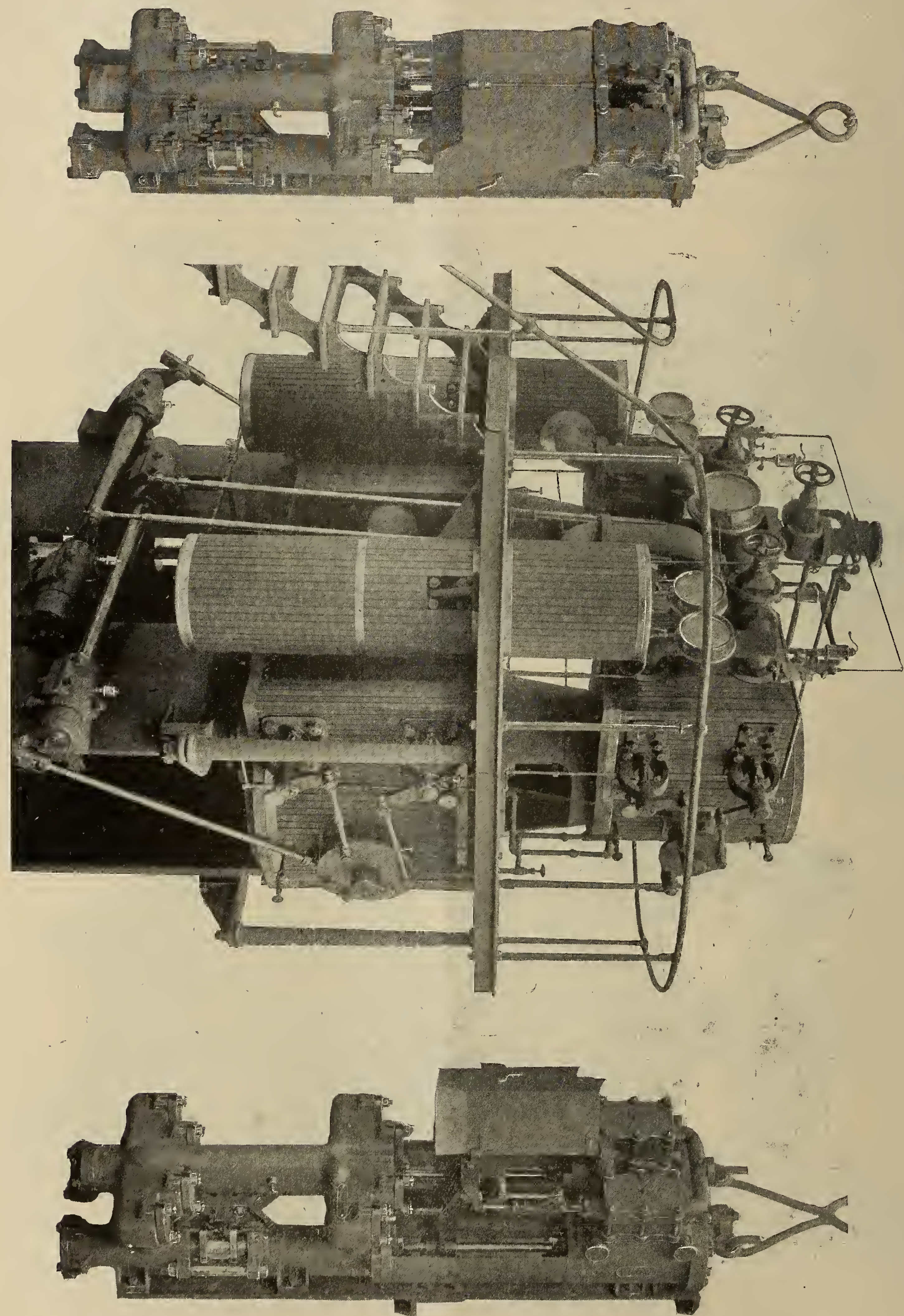
Snow Duplex Steam Pumps.

The country still possesses as one of its most charming features "the old oaken bucket by the well." But, fortunately, poetry has found its place on the tongues of gifted men; the old oaken bucket and the deep, cool well are still in retrospect, interesting to contemplate. They are faithful stand-bys, yet in the hurry and skurry of

this closing century have been left far behind, as the stone weapons of our earlier ancestors or the flint and steel of four score years ago.

Pumps, small enough to be carried in the swallow-tail of a dress suit, or gigantic enough to occupy the interior of a bank building, are used for an untold variety of purposes in a multitude of industries.

To educate the buyer of pumps up to a point where his intelligence will be of aid to him and to familiarize him with its purposes and parts, we introduce the following questions:

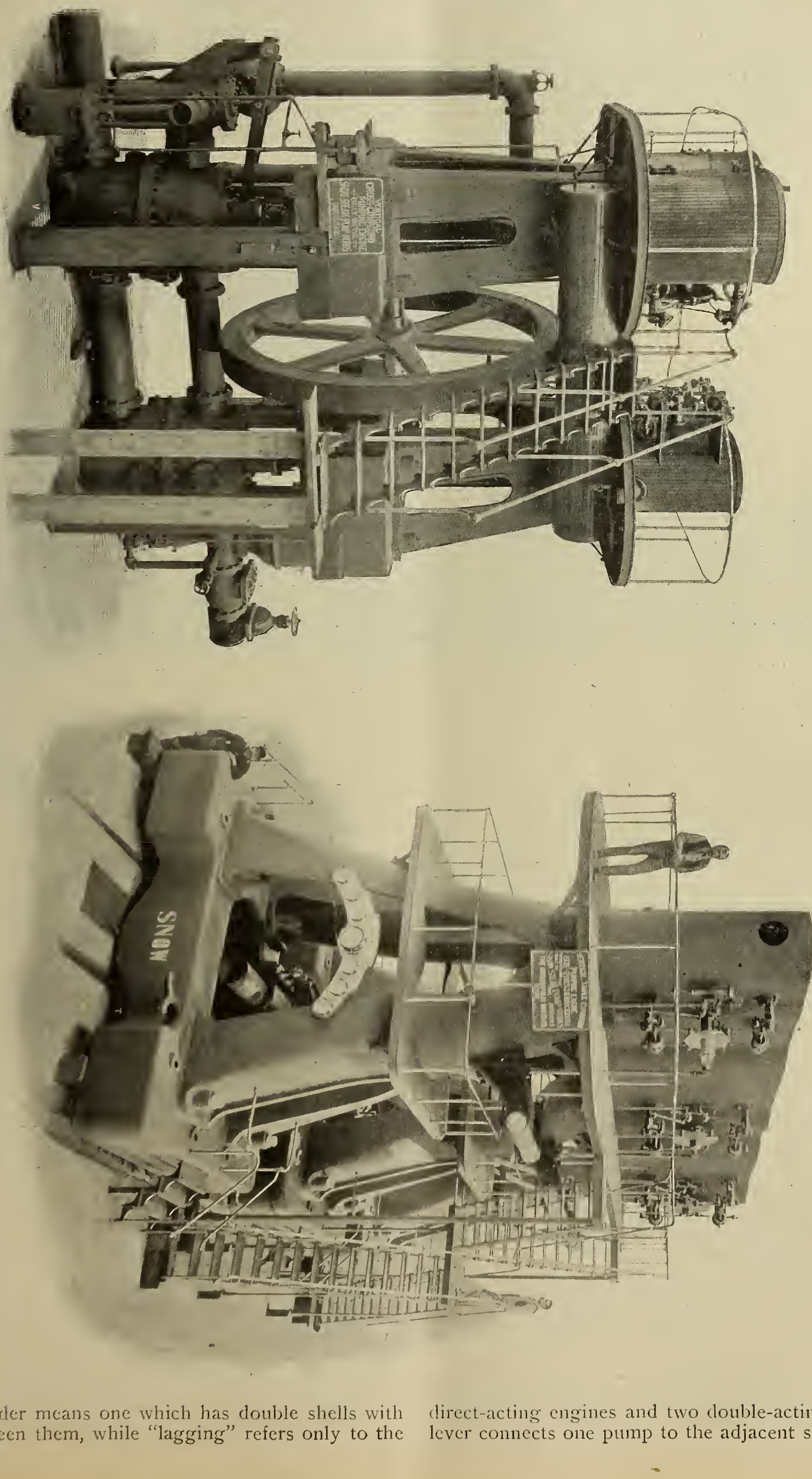


Snow Duplex Steam Pumps.

1. For what purpose is the pump to be used?
2. What is the nature of the fluid to be pumped? Is it hot, cold, salt, clear or muddy?
3. Amount required to be pumped per minute?
4. To what height or against what pressure is liquid to be pumped?
5. To what height is liquid to be lifted by suction?
6. State length and size of suction and discharge lines.
7. At what steam pressure is pump to be used?
8. In ordering parts, state pump number, diameter of steam and water cylinders, and length of stroke.

9. We encounter frequently a misunderstanding as to the difference between the terms "jacketing" and "lagging." We would state therefore that a "jacketed" steam cylinder means one which has double shells with steam between them, while "lagging" refers only to the external covering with non-conducting material and either wood, Russia iron or cast iron.

The Snow steam pumps are of duplex design—two direct-acting engines and two double-acting pumps. A lever connects one pump to the adjacent steam cylinder.



Snow Steam Pump.

The steam piston of one operates the valve of the other. At any point of the stroke the pumps may be started without any difficulty.

No noise or vibration, or even thump, so frequently present in other pumps, is observable in this one.

Several engravings of Snow steam pumps have been placed before the reader's notice.

For heavy-pumping, etc., they have found their place, and will retain it in the face of competition. The Snow Steam Pump Works are at Buffalo, N. Y. Mr. E. C. Lufkin is the general manager.

THE "HUNTINGTON" SEARCH LIGHT.

The Scott Electric Lamp Company have been and are manufacturing a style of search light superior to others on the market. In 1884 this new and original invention came out, but since then the improvement has been very great so that there are now, in addition to the original patent, three others of importance and value. The "Huntington" search light uses carbons about one inch in diameter, which are fed together as rapidly as they burn away. Within the lamp is a small magnet which separates the carbons when the current circulates. The upper carbon falls by gravitation, the magnet merely controlling the distance it passes through. The lamp carries a large lens and mirror projector. In the illustration the portability of the smaller sizes is presented to the reader's notice. These are frequently used on private yachts and many other purposes connected with marine work. The Scott Electric Lamp Company have obtained orders for one pilot and one bow search light with projectors to be used on two new boats now being completed by the Gas Engine & Power Company. These boats will be two of the finest pleasure crafts in these waters. The Scott Company claim that their 1897 type of search lights are electrically and mechanically perfect. Their orders for small, eight-inch portable search lights used on yachts are increasing every day, and they are worked day and night to meet the demand.

The Huntington Portable Search Light.

Van Cott'sElectric Foot Warmer.—Frank J. Van Cott, junior member of the wholesale grain firm of J. W. Van Cott & Son of this place, was seriously burned about the feet and legs, and the bed in which he was sleeping was entirely consumed, last night, as a result of placing an incandescent electric light globe at his feet when he went to bed. Mr. Van Cott and a party of young people were skating during the evening. Returning home at about 2 A. M., he found the fires low. He succeeded in warming his hands by grasping the globe of the electric light which hung in his bedroom. The result suggested a novel idea, and upon retiring he placed the globe at his feet, being able to do so on account of the length of the insulated wire.

He soon fell asleep, but was roused about an hour later by pain, and found the bedding and bedstead on fire. The lamp had broken and set fire to the sheets. His cries brought the elder Mr. Van Cott to the scene, and the bedding was promptly thrown from a window and entirely consumed in the yard below. Then the fire in the room was extinguished with buckets of water. Mr. Van Cott's injuries are serious but not permanent.—N. Y. Sun.

Albert Operti, the artist, whose Arctic scenes are unsurpassed, has a finely illustrated article on "The Sixth Peary Expedition" in The Home Magazine, of Binghamton, N. Y., for April. The subjects of the illustrations are original, and are furnished exclusively to this magazine. Mr. Operti's article gives a vivid account of the expedition, describes the methods he pursued in studying the Esquimaux, and securing plaster casts of types, and presents Lieut. Peary's plan—the plan which scientists are agreed is practicable—for reaching the North Pole. Coming from a man who has studied the ice floes and people of the North from the peculiar standpoint of an artist, this article is a particularly valuable contribution to the literature of Arctic exploration.

Every dollar of profit realized from "The Home Magazine" is devoted to the erection and maintenance of the National Home for Commercial Travellers, at Binghamton, N. Y.

Griffin, Ga.—Moore & McCray, Engineers, Atlanta, Ga., will receive proposals, April 1, for all machinery and labor for power transmission from High Falls to Griffin.

Electrical Rain.—M. Maurice Despres, an electrical engineer of Cordova, Spain, reports a remarkable shower of electrified rain which he recently witnessed. The day had been warm and windless, and about five in the evening the sun was overcast with dense clouds, lowering to the horizon. Soon after dark, there was a flash of silent lightning, and two minutes later great drops of rain fell, which cracked faintly on touching the ground. From each of them sparks darted towards the walls, trees and soil they fell upon. The phenomena lasted several seconds, and apparently ceased when the air between cloud and earth became saturated with moisture. Here, it appears, each rain drop was a miniature Leyden jar, charged with static electricity and insulated by the air so long as the air remained comparatively dry. Whenever a shower occurs the following raindrops gradually relieve the electrical tension of the clouds by thus leading the electricity to the earth, but it is extraordinary for the discharge to manifest itself so perceptibly.

Itasca, Tex.—C. C. Weaver, mayor, may give information concerning construction of an electric light plant.

Venus, Tex.—A. P. Thomas, desires estimates on cost of electric light plant of 200 to 300 lights.

Raleigh, N. C.—The Raleigh Electric Co. will rebuild power house destroyed by fire and resume the operation of its electric line.

"PIONEER" DRY BATTERY.

It is with great pleasure that we place before the reader's notice illustrations of the styles of dry cells manufactured by Mr. Vitalis Himmer, No. 162 William street, N. Y. These cells are noted among consumers and the trade for their long life and great output. They are built on thoroughly scientific principles, so that neither rapid polarization or diminution of current strength is likely to occur. Much time has been spent and many experiments performed for the purpose of determining the best size of cell for a given amount of work. Mr. Himmer has decided upon those sizes represented in the cut, which are one-half the real size, as being the least bulky and most efficient for the purposes in view. We heartily recommend them for any kind of work requiring open-circuit batteries. Mr. Himmer manufactures in addition electric clocks and novelties. Catalogues will be supplied on application and information concerning special sizes of dry cells.

Pioneer Dry Battery.

PRIZES FOR TWO INVENTORS.

A highly interesting competition between a large number of new inventions has just been decided by a very distinguished Board of Awards, and a handsome cash prize and solid gold medal awarded as the result of the decision. For some time the patent firm of John Wedderburn & Co., of Washington, D. C., have given a monthly reward of $150 to the inventor who should submit the best invention from the standpoint of simplicity, novelty and utility. The Board of Awards is composed of Senator William Stewart, of Nevada, Chairman; Representative Claude A. Swanson, of Virginia; Mr. John C. Eckloff, cashier of the Second National Bank of Washington, and Messrs. A. C. Moses, of W. B. Moses's Sons, and Frederick E. Woodward, of Woodward & Lothrop, two of the leading merchants of the capital city.

This Board has just selected the prize winners in the contest participated in by inventors who submitted their devices during the month of January. The prize of $150 goes to William Taylor, of Kearny, N. J., the inventor of a bicycle brake of simple construction, and the gold medal to Theodore G. Thomas, of Lamarque, Texas, for a monkey wrench of novel design.

NOTES.

MR. JONES of the Electrical Supply and Manufacturing Co., Cleveland, Ohio, is in town.

ALLEN C. BAKEWELL, Vice President and General Manager of the Interior Conduit & Insulation Co., left on the steamer Columbia, of the Hamburg line, for Europe. We wish him a pleasant journey and hope that this change of scene will be of benefit after the continuous strain of the past year.

GENERAL J. W. GODFREY, of the Habishaw Wire Co., was heard from in San Francisco March 29; said he was well and filling up orders.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING CO. are well settled in their new salesrooms and offices, No. 15 Cortlandt street. Messrs Harrington and Olsen are highly pleased with the change.

FRED. NOLL, representing the Interior Conduit and Insulation Co., in the metropolitan district, within twenty-five miles of City Hall, N. Y., is quietly hustling in big orders for Lundell fan motors. He is not shooting off crackers, but getting there with both feet. The big orders he is closing will show up into the thousands before the beginning of May.

ELMER P. MORRIS, one of our best known agents, is moving his office from No. 36 Dey street to Rooms 40-41-42 Smith Bldg, No. 15 Cortlandt street, N. Y.

NEW CORPORATIONS.

New York, N. Y.—The Payne Engineering Co. has been incorporated by Stephen H. Payne, Nathan B. Payne, and Albert G. Duncan; to deal in engines and electric apparatus. Capital stock, $10,000.

Hamburg, N. Y.—The Buffalo, Hamburg and Aurora Railway Co. has been incorporated by William W. Wheatley, of Brooklyn, and William J. Wright, of Buffalo; to construct a street surface electric road. Capital stock, $200,000.

Appleton, Minn.—The Appleton Electric Light and Power Co. has been organized with A. S. Williams, Manager, and E. Pickthorn, secretary and treasurer.

Norway, Me.—The Oxford Central Electric Road has been organized by Fred. C. Wilson, president; L. H. Burnham, vice-president; S. S. Stearns, treasurer; Freeland Howe, clerk; L. B. Wilson, chief engineer.

POSSIBLE CONTRACTS.

Crowley, La.—A. L. Chappuis, mayor, may be addressed concerning erection of an electric light plant.

Kansas City, Mo.—J. D. Stark, warden, may be addressed concerning establishment of $5,000 electric light plant.

Martin, Mich.—City clerk may be addressed concerning erection of electric light plant.

New Haven, Mich.—Village clerk may give information concerning construction of electric light plant, for which 10-year franchise has been granted.

South Lyon.—A municipal electric light plant will be established.

Augusta, Ga.—An electric light and power plant will be established.

Morris, Minn.—W. P. Fowler has commenced work on foundation for new electric light plant.

Brewton, Ala.—The mayor may be addressed concerning erection of electric light plant.

Brookhaven, Miss.—Address the mayor concerning construction of water and electric light plants.

Belmar, N. J.—The Atlantic Coast Electric Railway Co. has secured a franchise to construct and operate an electric line through certain streets of the borough.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued December 22th, 1896.

573,493. Electric Battery. Albert E. Stephenson, Chicago, Ill. Filed June 29, 1896.

573,496. Apparatus for Preventing Collisions on Electric Railways. Benjamin C. Tilghman, Jr., Philadelphia, Pa. Filed April 13, 1894.

573,517. Trolley Pole Governor. Vernon T. Lynch, Chicago, Ill. Filed March 4, 1896.

573,526. Electric Arc Lamp. Eugene Hugo Arthur Heinrich Ritter von Nollendorf, Vienna, Austria-Hungary. Filed April 9, 1896.

573,535. Trolley Adjusting and Regulating Device. Charles F. Randall, Denver, Colo. Filed March 31, 1896.

573,558. Electrical Resistance Device. Detlef C. Voss, Malden, Mass. Filed March 16, 1896.

573,575. Telephone Exchange System. William W. Dean, St. Louis, Mo. Filed June 11, 1896.

573,576. Common Battery Telephone System. William W. Dean, St. Louis, Mo. Filed September 19, 1896.

573,581. Electric Engine. Isaac T. Dyer, Chicago, Ill. Filed March 30, 1896.

573,591. Electric Signaling Apparatus. Felix B. Herzog and Schuyler S. Wheeler, New York, N. Y. Filed March 12, 1885.

573,592. Electric Signaling Apparatus. Felix B. Herzog and Schuyler S. Wheeler, New York, N. Y. Filed January 29, 1886.

573,601. Electrical Switching Apparatus. Francis W. Jones, New York, N. Y. Filed October 15, 1896.

573,612. Electrical Connecting Cord. Charles H. McEvoy, Lowell, Mass. Filed February 24, 1896.

573,617. Electric Arc Lamp. Paul Franz Herrmann Queisser, Charlottenburg, Germany. Filed January 24, 1896.

573,629. Electric Heater. Harry L. Tyler, Corning, N. Y. Filed August 6, 1896.

573,645. Automatic System of Distribution and Control for Electric Railways, etc. William H. Cooley, Brockport, N. Y. Filed August 3, 1895.

573,647. System for Generating and Distributing Electrical Energy. Charles M. Green, Cleveland, Ohio. Filed May 23, 1896.

573,716. Electric Signal Operating Device for Railway Trains. George F. Singer and Frank K. Singer, Mingo Junction, Ohio. Filed May 22, 1896.

573,723. Electric Floor Push. Henry C. Thomson, Boston, Mass. Filed March 28, 1896.

573,741. Electric Metal Separator. Harvey H. Whitacre and Andrew C. Wolfe, Wellsville, Ohio. Filed November 8, 1895.

573,750. Combined Lightning and Water Conductor. Lawson Adams, Buffalo, N. Y. Filed September 30, 1896.

573,767. Automatic Speed Regulator for Electromotors. Louis Denayrouze, Paris, France. Filed November 26, 1895.

573,807. Electric Switch. Walter Boardman and Harris Boardman, Lancaster, Pa. Filed March 28, 1896.

573,809. Elevator Mechanism. John H. Clark, Boston, Mass. Filed July 28, 1890.

573,817. Electric Light Support. Elisha J. Fulghum, Traverse City, Mich. Filed June 24, 1895.

573,819. Electric Railway. Paul W. Leffler, Chicago, Ill. Filed August 12, 1895.

573,820. Electric Elevator. Paul W. Leffler, Chicago, Ill. Filed August 19, 1895.

573,821. Electric Railway, etc. Paul W. Leffler, Chicago, Ill. Filed September 26, 1895.

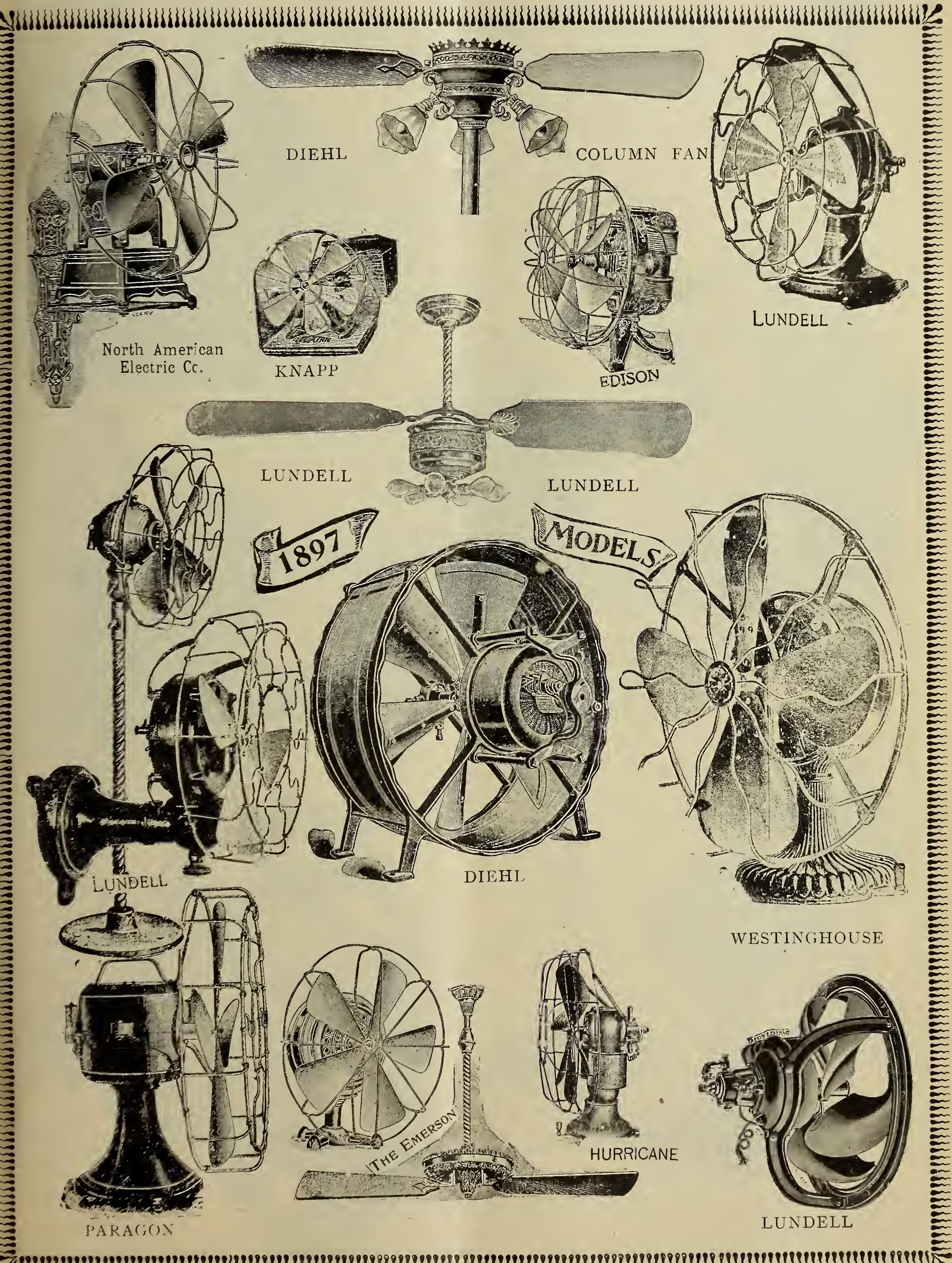
573,822. Electric Railway, etc. Paul W. Leffler, Chicago, Ill. Filed March 11, 1896.

573,823. Motor Car Truck. Paul W. Leffler, Chicago, Ill. Filed March 21, 1896.

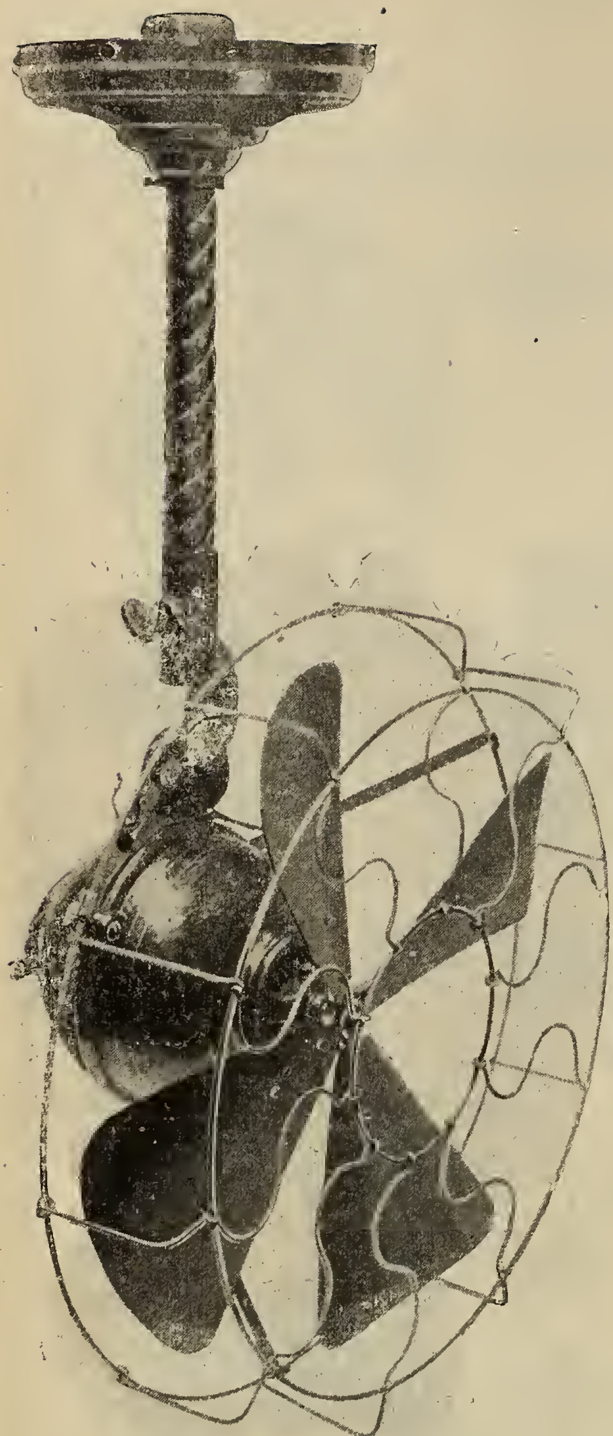
573,830. Electric Arc Lamp. John A. Mosher, Chicago, Ill. Filed October 22, 1896.

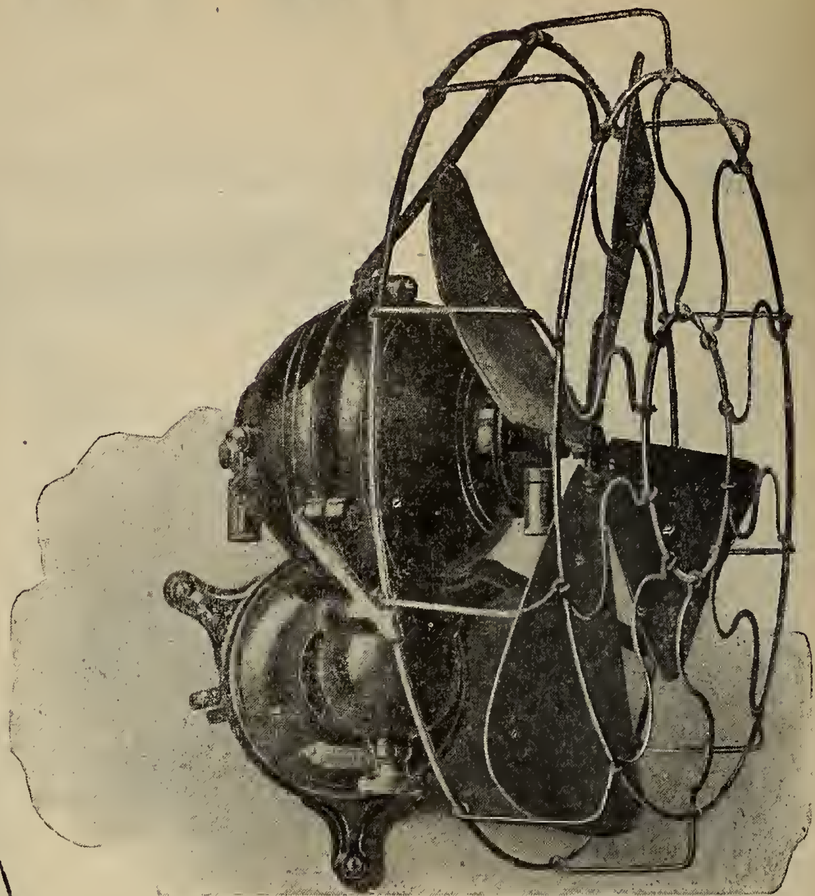
The Electrical Age.

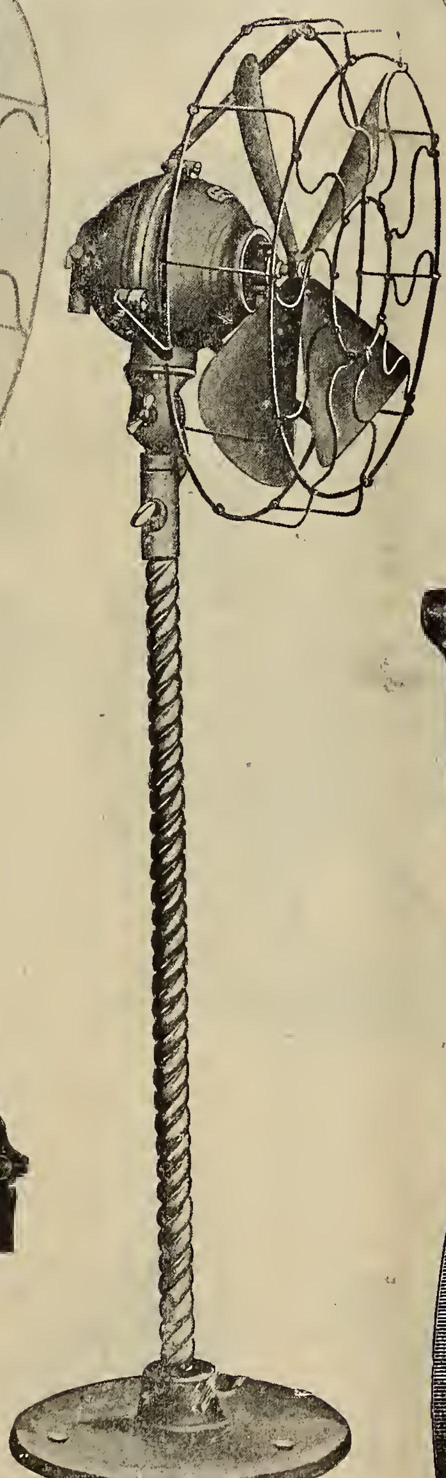
Vol. XIX., No. 15. NEW YORK, APRIL 10, 1897. Whole No. 517

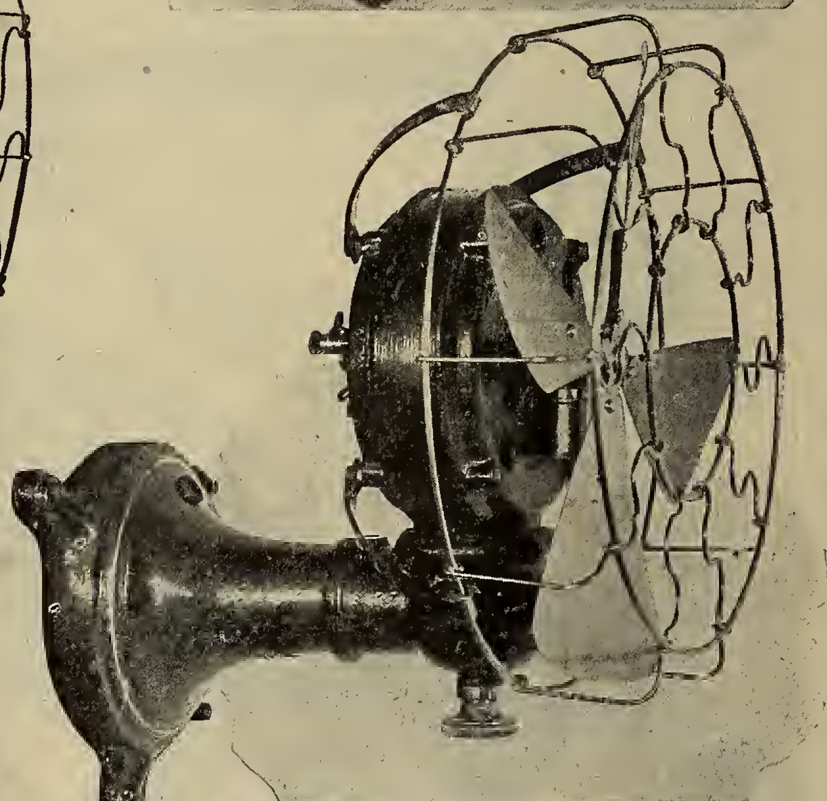


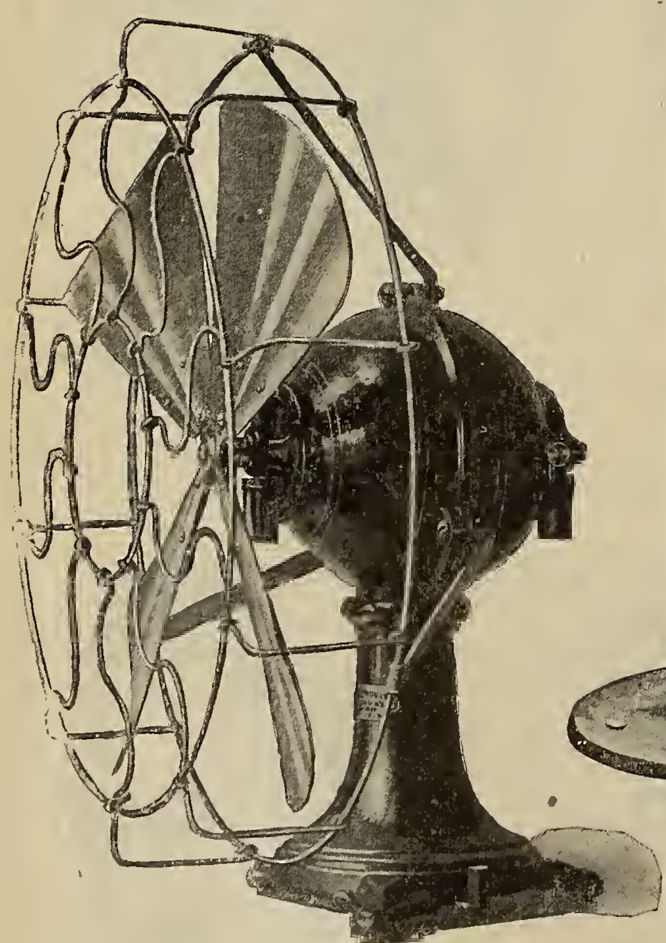
ADVANCE AGENTS OF SUMMER BREEZES.

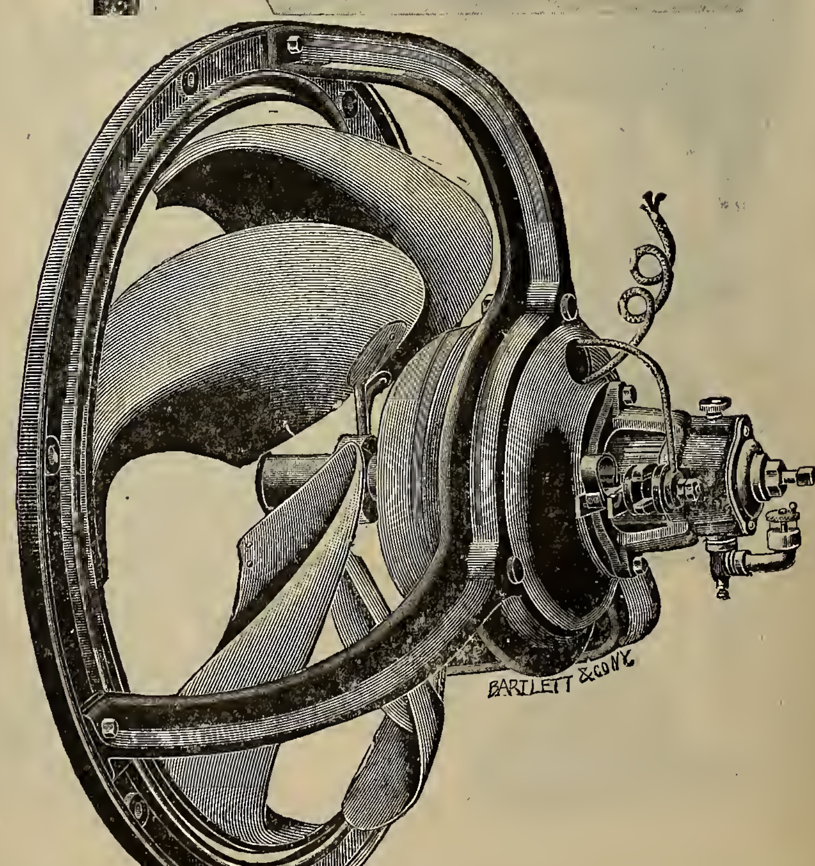












Lundell Suspended Direct-Current Fan Motor.
Lundell Portable Direct-Current Fan Motor.

Lundell Direct-Current Column
Fan Motor,

Lundell Direct-Current Bracket Fan Motor.
Lundell Alternating-Current Bracket Fan Motor.
Lundell Exhaust Fan.

FANS AND VENTILATING OUTFITS.

The use of fans for the expulsion or introduction of fresh and cool air has become so universal that we doubt whether any industry has branched out as suddenly and successfully. They have entered so intimately into the hygiene of public buildings that their application is considered indispensable. It is not many years since the electric fan or ventilator was a luxury that might be more expected in the sumptuous chambers of some magnate than the modest home. Yet not only the wealthiest but the poorest in certain respects may enjoy the pleasure of being cool in summer or sleeping soundly during the sweltering nights of July and August.

The fan has entered the home, the theatre, the restaurant, the business office; in the hospital the fever patient has felt its grateful breeze and heard its busy hum with gratitude that was inexpressible.

Manufacturers all over the country are getting their goods ready for public inspection. Orders must be placed months in advance, and those desirous of dealing are deciding upon their choice even now. The numerous purposes to which the whirling blades can be put have made many apply them in a unique manner.

Generally speaking, we have the

(1) Fan motor,
(2) Long-bladed ceiling fan,
(3) Exhaust and pressure fans.

The first is used in offices, homes and rooms in general.

The second in restaurants, shops and hotels.

The third in basements, engine rooms, or any case imaginable where a great volume of air is to be continually expelled and purified.

The following descriptions relate to the apparatus which has been called by the name of Fans and Ventilating Outfits:

Lundell Direct, Alternating and Exhaust Fans.

The Interior Conduit & Iusulation Co. have made their mark among consumers and the trade by introducing the most compact type of motor ever placed before the public eye. The popularity it has gained and the satisfaction it gives, can be faintly estimated by a general survey of those places using fans, which includes numerous restaurants and thousands of clubs, theatres, churches, etc.

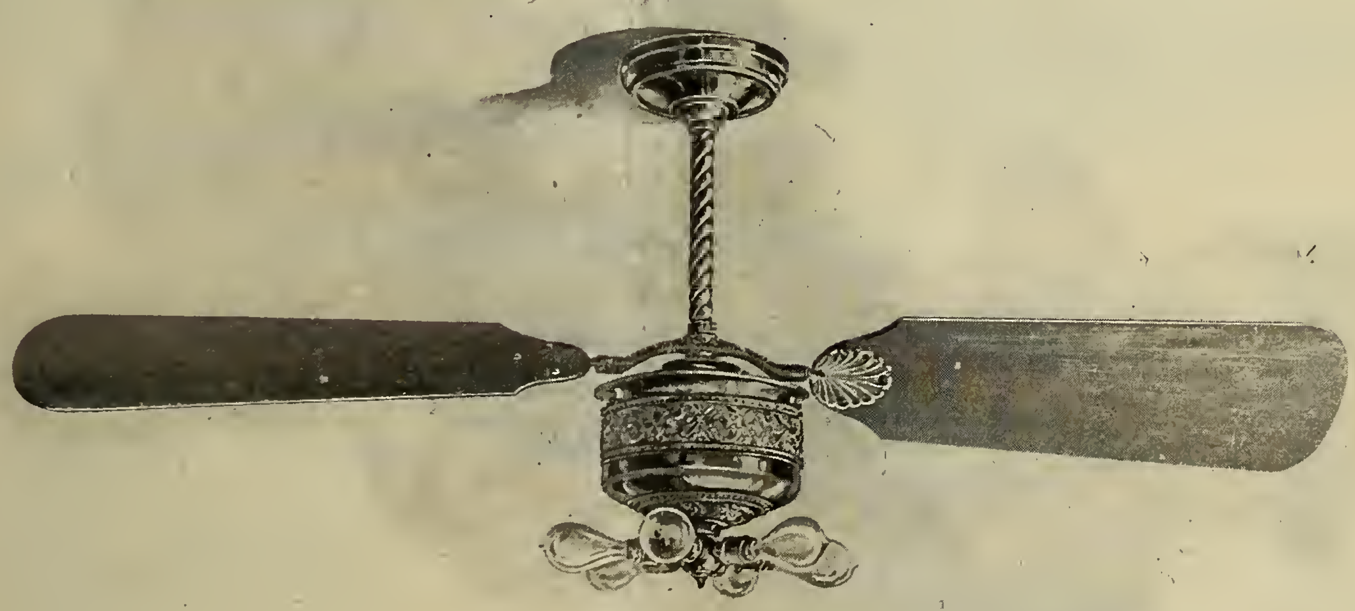
The illustrations will give the reader a general idea of the appearance of their different types including the large exhaust as well as the latest innovation, the fan motor with a wall bracket.

The portable fan to be set on a table, desk, etc., has self-oiling bearings and is completely ironclad. The guard is strong and securely fixed. The fan is noiseless and does not heat. No hot air is thrown and no bother experienced. The fans on uprights are supported upon the floor, the base being screwed down, the fan pointed in any direction required.

The wall bracket fan is particularly fine as it can be moved to any angle, so that its breeze may be directed wherever desired. The base is screwed to the wall and has a joint that allows the body of the fan to move freely. It is ingenious and satisfactory from every electrical and mechanical standpoint.

We desire to call particular attention to their suspended fan motors, they can be hung from the ceiling and the fan se aı any angle.

The heavier outfits for exhaust or pressure blowing give a perfect blast of air. They are made of usual sizes and are supplied with the latest Lundell motors, that will stand a continuous run of hours without heat or injury, self-oiling bearings, carbon brushes and a well balanced and ventilated armature make them reliable and economical.



Lundell Direct-Current Ceiling Fan Motor.

A solid mechanical construction prevents vibration of any kind and oil throwing does not occur.

The perfection of Lundell machinery is attested to on every side. The Interior Conduit and Insulation Co., No. 527 West 34th Street, are the manufacturers.

Diehl Fans.

The Diehl fan is well known to hotel proprietors, etc., and their opinion of its qualities would probably suffice.

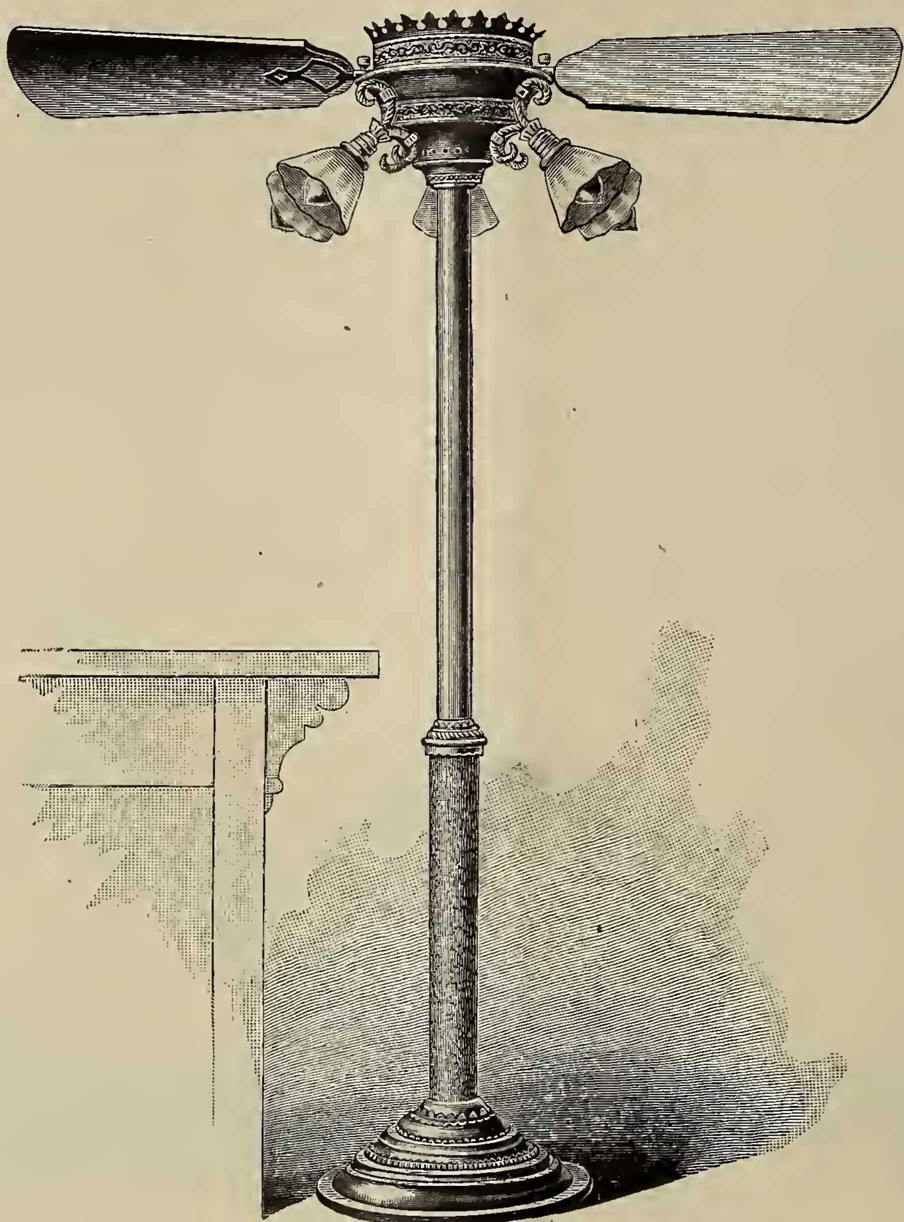
But we may at least refer to its elaborate finish and perfection of action without more than indicating its real excellence. When attached to the ceiling it presents a very ornamental appearance. As per illustration it can be supplied with lights or not as desired. The speed is uniform and the breeze unfluctuating. Made in two or four bladed designs, the customer can make whatever choice he sees fit. The armature is well ventilated, having plenty of radiating surface, and the bearings afford the most perfect fit and lubrication.

The commutator does not deteriorate because the brushes press firmly, and sparking is entirely absent. The Diehl column fan, resting upon the floor, is as highly finished and as ornamental as the ceiling fan.

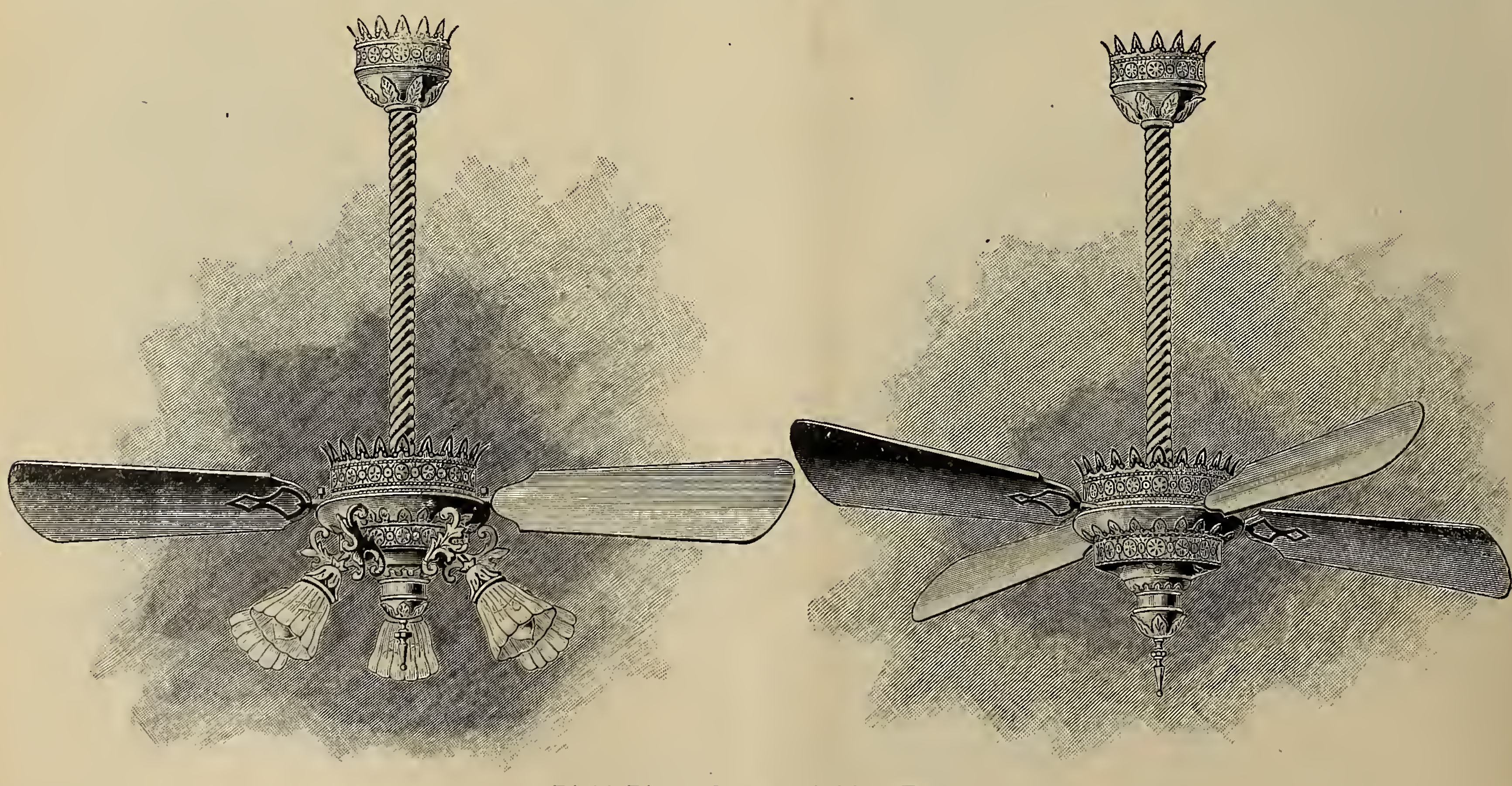
No tremor is visible, and the little attention required have made them very popular among the trade. Lamps may be attached and the double service performed by it, that of giving ventilation and light. The Diehl Company have their factory at Elizabethport, N. J. Their New York office is at No. 561 Broadway, New York.

They call particular attention to the combination of their Diehl motor and Wing exhaust fan, an illustration of which is found in this number.

The Diehl motor can stand the heaviest load the Wing fan can put upon it with their blades set at the angle for exhausting the greatest amount of air. The popu-



Diehl Column Fan.



Diehl Direct Current Ceiling Fans.

larity of this outfit as a ventilator has been established in all fields of work.

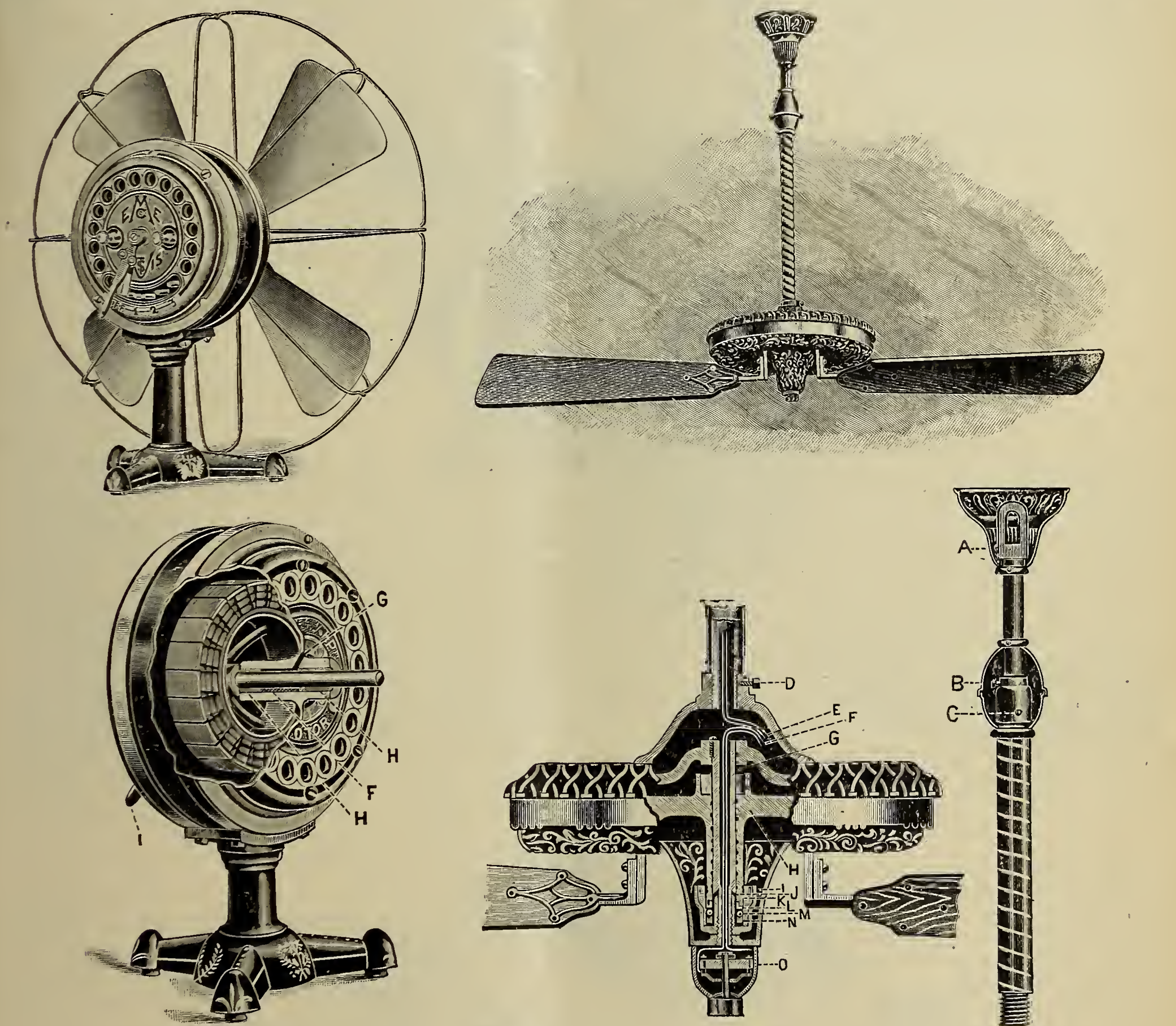
The Emerson Alternating Portable and Ceiling Fans.

The alternating current was with difficulty applied to any other purpose than electric lighting in the past.

Many experimented with numerous designs of motors for the purpose of utilizing it for power. The Emerson Motor Co. of 716 St. Charles street, St. Louis, Mo., were the first and only ones that had a successful alternating-current fan motor upon the market. The armature is devoid of any insulation and runs no risks of a burn out. A regulating switch controls the power consumption of the motor and is very ingenious. It can keep the speed constant yet reduces the watts if extreme economy is desired. The efficiency of this motor is very high, the 12-inch taking from 45 to 50 watts, while others consume when running the same sized fan from 120 to 160 watts. The oiling of this motor is effected by a special graphite lubricant, a strip of felt conveying it to the shaft. The motor will run untouched for weeks. The outside of the new 1897 models are finished in aluminium or plain bronze with polished nickel bands outside. It presents a very handsome appearance, gives an excellent breeze and enjoys the prestige of a priority and the recommendation of the trade.

The ceiling fan is constructed with the object of giving the least possible trouble when installed. It is built on the same simple lines as the portable fan and is free from oil spattering, heating, vibration or hum. In both these fans ventilation is carefully attended to and the details of construction.

The bearings are faultless, and the fan, when supported, swings freely and without effort upon a ball bearing. The absence of moving wire, reduction gears or wearing parts, makes it the ideal fan. The blades swing at a speed of from 150 to 210 per minute The fan blades are set at the proper angle, and any change in the breeze is obtained by the regulating switch which cuts it down to about 150.



Emerson Alternating Portable and Ceiling Fans.

Its excellent features are such that its sale has increased greatly and the factory is now hustling to meet the rush of orders.

North American Electric Co.

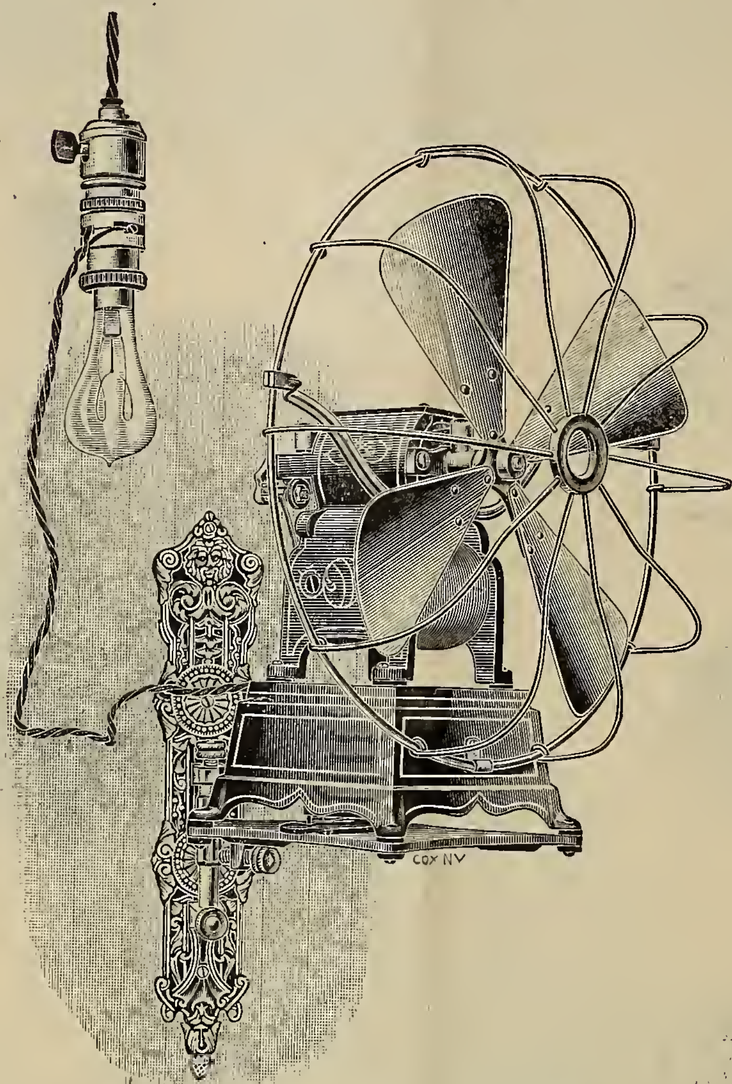
There are but few manufacturers of fan motors that have gained a better or more enduring name than the North American Electric Co. Their address is 181 William Street, and visitors are welcome to see the quality of material and methods employed. The fan motors are in detail very carefully made, and when assembled are strong and ready for continuous work.

Their Incandescent Fan Motor for 110 volts runs a 12-inch four-blade fan. It has two speeds and is equipped with the new and improved brush holders.

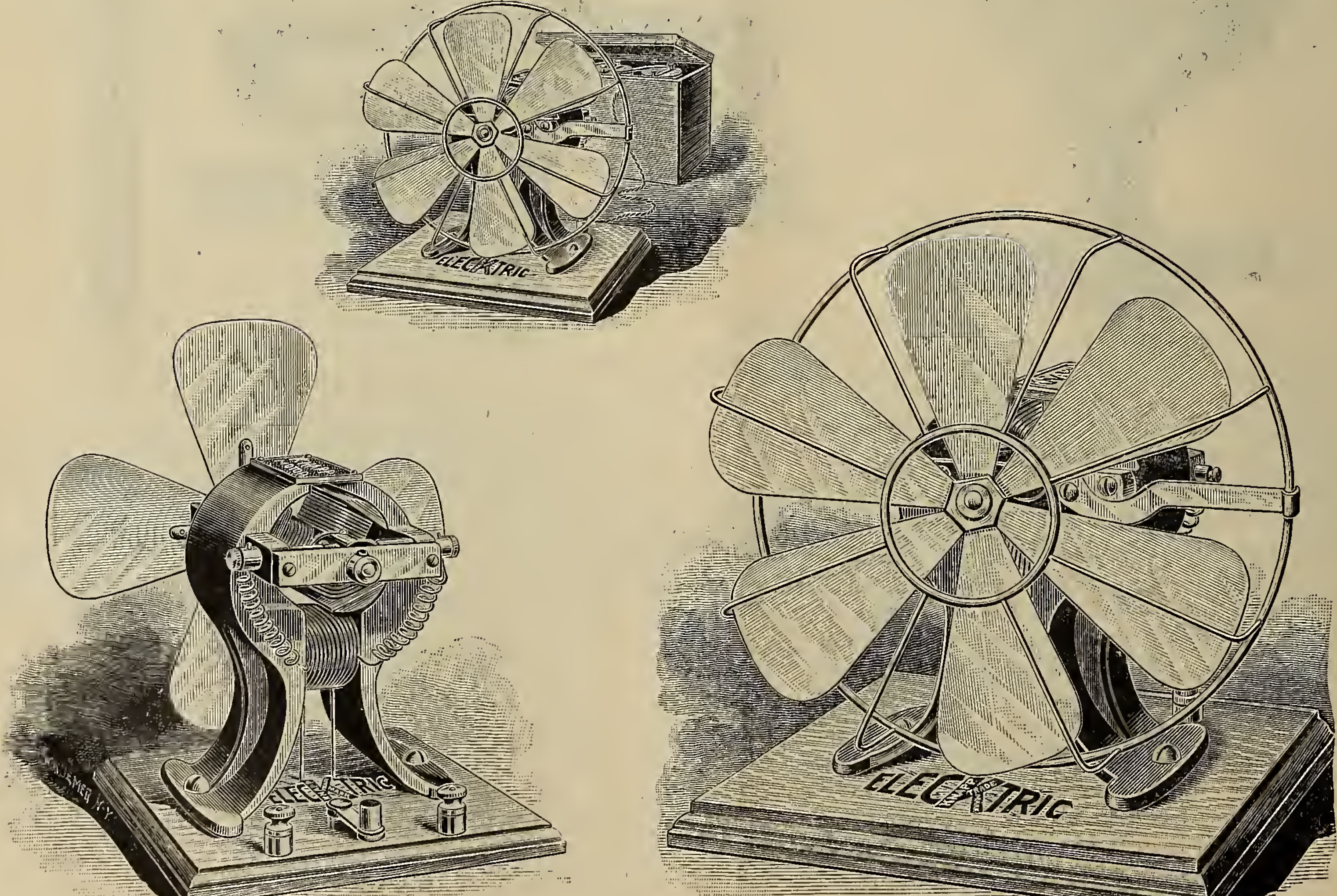
Those that desire a handsome, well-designed and

smoothly running fan, can do no better than call to see the North American Electric Co.

The variety of styles which they manufacture and the careful attention given to every detail will be a surprise to the casual visitor. The prices are extremely low for the high quality of their goods.



North American Electric Co.'s Direct-Current Fan Motor and Bracket attached to Vetter Current Tap.



Knapp Portable Battery Fan Motors.—(See Page 232.)

The adjustable bracket serves the purpose of a support which can be raised, lowered or moved sideways. They are made for any motor and by their use the current of air can be turned in any direction. The Vetter current tap is used exclusively by this company in connecting up their motors.

The lamp can burn and the motor be tapped from its socket at the same time. The motor, bracket and current tap form a perfect fan motor outfit that never fails to give the best of satisfaction.

The Electrical Age.

ESTABLISHED 1883.

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CONTENTS.

THE NEW ERA.

Many important changes in the industrial world have been anticipated by those laboring for its development and progress. Hero of Alexandria rotated a metal sphere with great rapidity, actuating it entirely by steam. Humanity being alike the world over, probably many of his subjects thought the time had arrived then for the widespread use of steam turbines. Yet centuries rolled on their swift course before the properties of steam were rediscovered or the experiment of this enterprising ruler revived. In contrast with this early period of infertile thought and sluggish application we are brought face to face with the present day. The nineteenth century began under the happiest auspices. It might be said that mankind stood at the threshhold of true enlightenment, better prepared in mind and experience than ever before to receive its benefits. As the years sped by eaeh left its impress upon those that succeeded it. The steam engine of Watt, the steamboat of Fulton and the locomotive of Stevenson are prominent landmarks in the field of industrial life. Then with quickly hastening footsteps came the genius of electricity. The telegraph and telephone, dynamo and motor, arc and incandescent lamp—these and a thousand others formed an irresistible battalion for the introduction of innovations. The latest is the electric carriage, whose anticipated future will be sure to further its prosperity and success as a common vehicle of street hire.

The cabman and carriage driver of the Grand Central Depot will have to invent some new cry other than "Cab or carriage, sir?" He may invite some eligible hayseed to step into his automobile.

OPEN CONDUIT ELECTRIC ROADS.

The third-rail system has been proving its efficiency on the Brooklyn Bridge. There is every reason to expect that its continued use will deprive the Manhattan Railroad Company of any excuse regarding the application of electricity to elevated roads. In the street, the flow of water and heaping up of snow, slush and refuse has made the open conduit electric road a matter of experiment. The Lenox avenue line has been successful as far as is known, and in all probability the other surface lines, including those already equipped with cable, will turn to this system as the most economieal. Roads that are rushed during certain hours of the day and are likely to meet with a breakdown are taking into consideration the desirability of changing over to electricity. At present the open conduit seems to be the most favored system.

BURNS FROM X RAYS.

The physiological effect of X rays upon the skin is somewhat similar to a sunburn whose development is retarded. In the case of X ray burns the cuticle is affected as follows: By exposure the skin reddens, after the lapse of some days, when apparently all traces have disappeared, the sloughing and wasting of the affected surface takes place. Cases have occurred in which an arm, a hand or a wrist evinced all the symptoms of exposure to the sun, but with apparently more dryness, though the same redness. The article by Elihu Thomson is instructive, giving the results as noted by direct experiment. Whether a burn or a new physiological trouble, we will let the doctors decide. The facts may be at least studied by tbe general reader from the article by Thompson. It might be wise, in the future, for those experimenting with X rays to encase their hands or arms in coverings of non-permeable material.

Emery to Corundum.—One of the latest achievements of the electric current is a process of converting emery into corundum by means of the alternate current arc that has recently been patented. As heat and not decomposition is aimed at, continuous currents would be unsuitable. This furnace is made of firebricks and stands on two bridges; the hollow underneath serves as a receptacle for the fused mass, there being a small hole in the bottom of the furnace. This hole is covered with a glass plate. The electrodes—carbon rods—are approached to within one inch to two inches, the space between being packed with lumps of carbon. The emery, the finest dust, of little use otherwise, is mixed with powdered coal, the amount depending upon the iron oxide in the emery; for 25 per cent. of oxide five per cent. of carbon is reckoned. The coal is soon burned by the oxygen of the iron oxide and the arc forms. The inner mass begins to melt, and the glass plate gives way, and a stream of fused corundum flows out. The hard outer crust is then broken with iron rods and new material thus fed to the arc. This addition stops the flow, which starts again after ten or fifteen minutes. The base-plate is strewn with fine emery powder to protect it from the intense heat of the fused mass. The resulting corundum is almost free of water, of which the emery contains about five per cent. It is crystalline, colorless, and then resembling quartz; pink or blue, fine, small crystals of sapphires have been found in druses. The current is kept at 250 amperes and the pressure is 40 or 60 volts.

Knapp Battery Motors.

Battery motors have occupied a unique position in the market for many years. They are the real pioneers of the fan motor trade, and their present increasing use is an indication that they are doing their work well. The Knapp Ventilating Fans, sold by the Knapp Electric and Novelty Company, 47 Warren street, New York, are made of the inverted horseshoe type. The motor is mounted on a wooden base and has an armature that runs with little friction. They are excellently made, being supplied with a starting switch which places it under control and connecting cords which run to the battery. Mr. Knapp has spent years of time in perfecting his motors for the publie, and can now feel that his work has been conscientiously performed.

For the desk, home or sickroom the comfort of this little fan is very great. The battery employed is one of constant current, without odor or waste when not in use. They do not require attention and will run the motor 150 hours before recharging.

The types manufactured by Mr. Knapp bear the name of Little Hustler, running a three-bladed five-inch fan, taking from one to two volts; Type B, four-bladed, six-inch fan, taking from one to four volts; Type C, a four-bladed eight-inch fan, taking from two to six volts, and the Type D, running a six-bladed ten-inch fan, requiring from two to eight volts.

The long life of the batteries, the good workmanship of the motors and the satisfaction received by customers have always been ready recommendations for the sale of these fans.

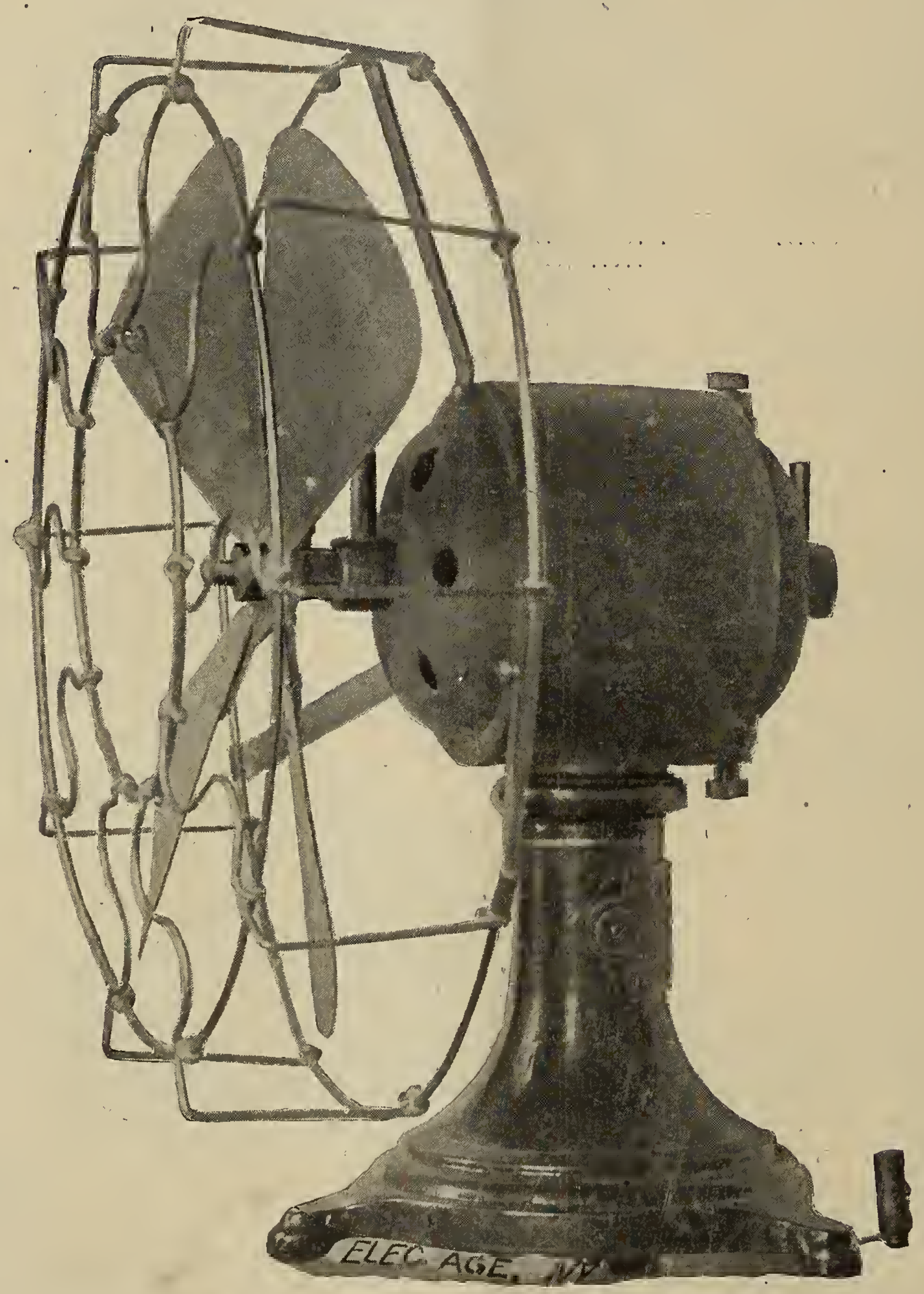
Riker Direct Current Fan Motor.

We note that the Riker Co. have not found it necessary to alter the form or construction of their 1896 fan motor. They feel that special attention should be directed to its high efficiency and perfect operation.

The speed of the fan is limited to 1,800 revolutions a minute, and not more than one-quarter of an ampere is consumed. This is guaranteed by the manufacturers. They also wish to emphasize this fact to buyers; their representatives will be pleased to call and demonstrate the perfect simplicity and high efficiency of their motor.

The radiating surface on the armature and field keeps it cool when running. No sparking occurs at the commutator or vibration of the fan itself.

The Riker Electric Motor Co. furthermore desire to state that they have not taken orders in blocks of 10,000, as some of their competitors have done, but are finding a ready market with the leading supply houses. The address of the Riker Electric Motor Co. is No. 45 York Street, Brooklyn.

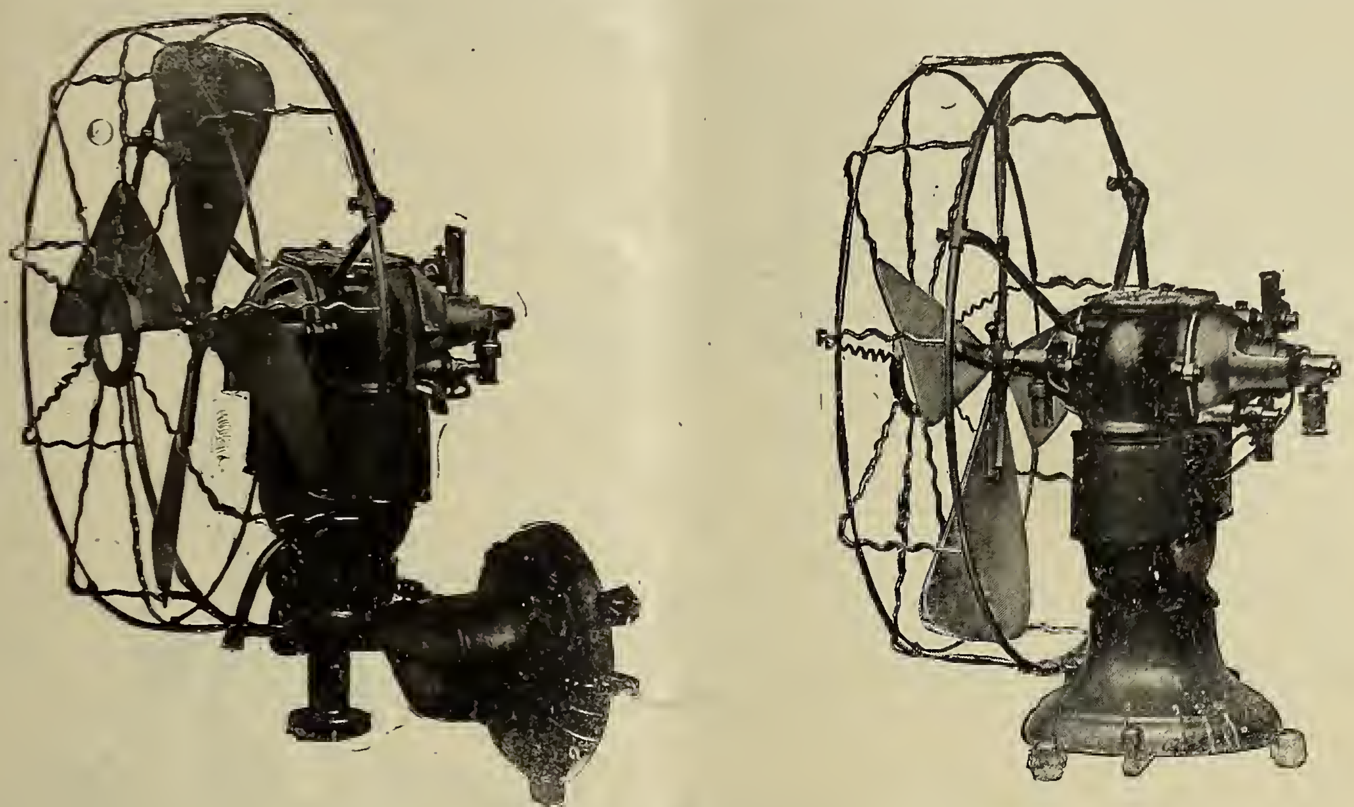


Riker Direct-Current Fan Motor.

The Hurricane Fan Motor.

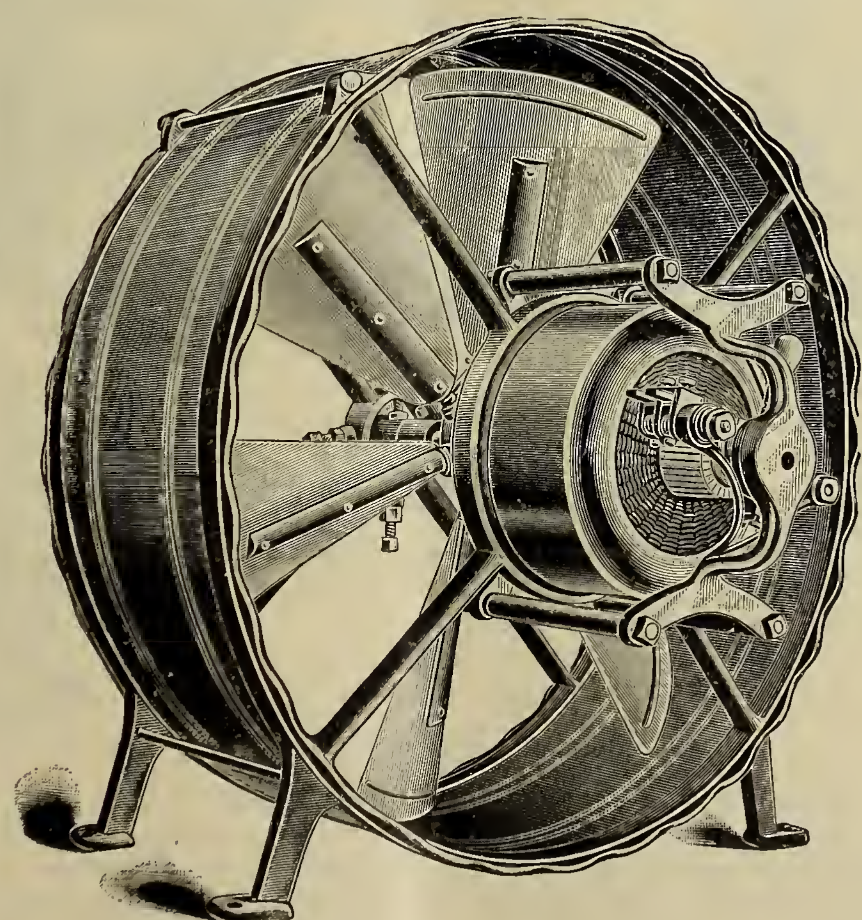
The breeziest and most suggestive name has been given to this fan motor. It is called the Hurricane, and deserves its appellation in every sense of the word. It will "raise the wind" for its manufacturers, Goldmark & Wallace, as well as the many customers that buy it. The fan is well made from a mechanical and electrical standpoint. Self-oiling bearings and a well-centred ironclad armature. A small air gap and a large commutator, wrought-iron field cores to which the pole-pieces have

been cast, comprise an ideal magnetic circuit. The brushes are self-feeding and do not spark. Neither the armature nor field ever get hot, ample radiation being secured by a careful proportioning of parts. The switch



Eck Bracket and Portable Direct-Current Fan Motors.

supplied will start and regulate for three speeds. The armature can be readily removed by loosening the front bearing. The entire motor is made with a careful attention to details and indicates the most critical selection of material. The fan and ornamental guard are very handsome in appearance. The guard is readily removed or attached. The fan, strong and well made, makes no noise and does not tarnish. Each motor is carefully



Wing Exhaust Fan and Diehl Motor.

tested before leaving the factory. They are made of sizes one-eighth and one-sixth horse-power, driving twelve and sixteen inch fans. The wall fan motor can be pointed in any direction. A universal ball joint allows freedom of position. The base of the machine is secured to the wall as per illustration. The breeze may be thrown in almost any direction. Agents and manufacturers are Goldmark & Wallace, No. 29 Chambers street, New York.

Wing's Disk Fan.

The Wing Disk Fan has earned a name for itself as being one of the earliest pioneers in the art of ventilating. The electric motors which drive them are practically part of the fan they drive, and consume the least possible power. The light is not interfered with when they are inserted in the window, and their noiseless operation makes them very desirable.

This strong and well made fan has been adopted by the Diehl Co. in connection with their motor.

The innumerable places in which Wing fans are used may be roughly estimated. A few of them are hotels, restaurants, laundries, mills, mines, cold storage rooms, etc.

The list could be extended until the reader felt overpowered. The blades of this fan (see sketch) are attached so firmly to the radial driving arms that they could never fly out; the blandes can be set at any angle. Their solidity of attachment also prevents vibration and sends forward a powerful blast of air. The Wing fan is

manufactured by L. J. Wing & Co., No. 109 Liberty Street, N. Y.

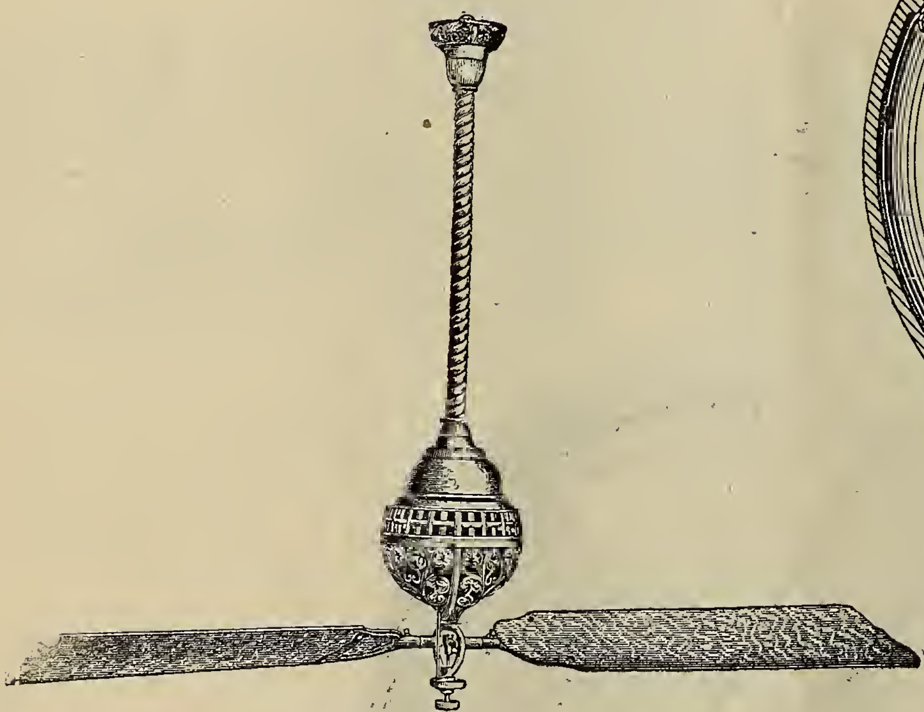
Tuerk Alternating Current Ceiling Fan.

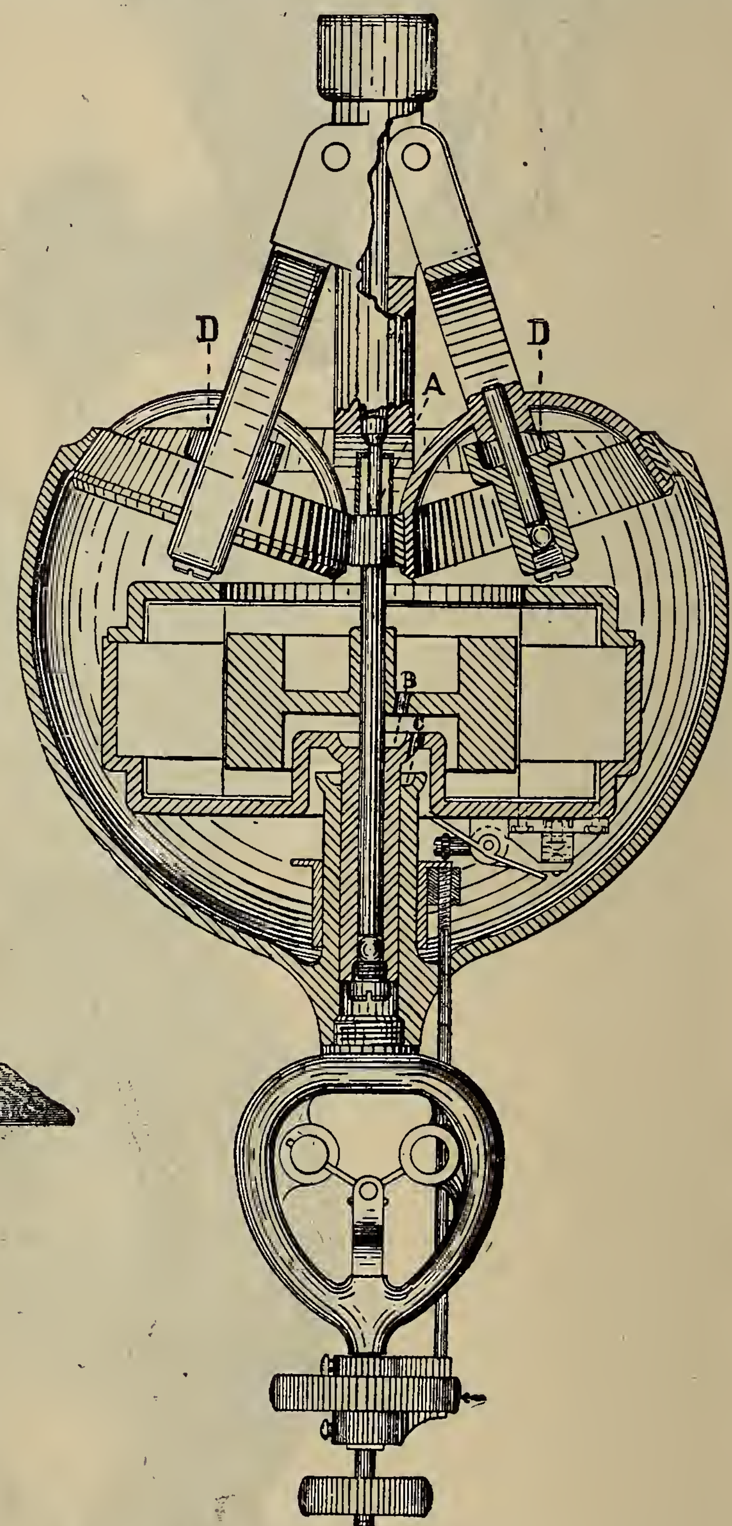
The utilization for the alternating current for ceiling fan motors was a labor that required considerable ingenuity and persistence. In the illustration the mechanism of the fan brought out this year (1897) is depicted. The motor driving the fan is of the induction type and runs at a speed of 1,800 revolutions per minute.

A vertical shaft carries a conical hub upon which rests two rollers. The rollers are at an angle and have resting upon them the casing of the motor. The revolution of the shaft rotates the rollers and they in turn move the outer shell. The shell always makes a tight fit with the rollers, permitting motion but not vibration. The fan casing and fan blades supply sufficient weight to keep the hub, rollers and surface they rest against always in excellent contact. Being dust proof no trouble is experienced from dirt entering the fan, and the use of ball bearings for the rollers affords the best sliding contact imaginable.

The fans take from 120 to 140 watts at 150 revolutions a minute with the blades properly set. The voltage they are made for lies between 50 to 120 volts and the frequencies from 60, 125 to 140 per second.

It might be incidentally mentioned that the bearing surfaces act as reduction gears. It will take (see sketch) a great many revolutions of the motor shaft or hub to turn the outer casing once.





Tuerk Alternating Current Ceiling Fan Motor.

The fan is well finished in bronze, nickel, gold, etc. The manufacturers are the Hunter Fan and Motor Co., Fulton, N. Y. Eastern Agents, E. B. Latham & Co., 136 Liberty Street, N. Y.

These gentlemen have been pushing the fan trade very hard this season, and their orders are piling in.

ROENTGEN RAY BURNS.

BY ELIHU THOMPSON.

The cause of the injury to the skin which follows an exposure to a source of Roentgen rays is still a subject for discussion. It is known that a comparatively short exposure at sufficiently small distances from the source will produce the effect. It has been claimed by some that Roentgen rays do not produce the mischief, but that the effect is essentially electrostatic. Others have expressed the opinion that ozone and other substances present in the neighborhood of the excited tube are the real causes of the injury.

It has seemed desirable to set at rest by experiment these doubtful theories. The very peculiar nature of the injury itself, its course of development, the accidental circumstances under which it has occurred, have all tended to negative any theory except that which regards rays from the tube as the true cause. These rays might

be either Roentgen rays, or rays so closely analogous as to be with difficulty distinguished therefrom.

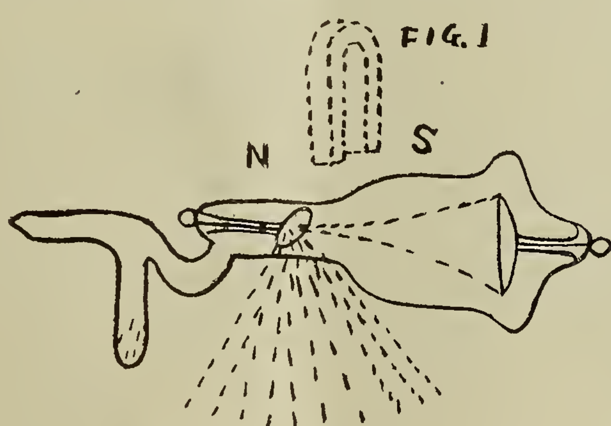
The first effect after exposure is a slight reddening of the skin, which is made more easily discernible by a little friction over the spot affected. This lasts two, three or more days and tends to fade. In the writer's experience, at the end of a week there has been an almost complete absence of any noticeable effect on the skin. On the ninth day, however, the affected part was found to redden, and this increased for a few days until blistering and sloughing took place with slow and tedious healing. These effects were noted in the case of the exposure of the little finger of the left hand and are, at present writing, in progress upon a portion of the third finger of the same hand, in consequence of an exposure for only twelve minutes to the rays from a special tube. This tube was made for the purpose of obtaining strong effects by lessening the working distance from the bombarded spot on the platinum, which is the source of the rays.

Fig. 1 shows the general form of the tube. It is narrowed around the platinum anode and the glass is also made thin around the same. It is thus possible to get the finger, the fluorescent screen, or the photographic film, very close to the bombarded spot on the platinum anode. The distance need be not over one-half an inch as a minimum. By the use of a magnet the spot on the platinum could be shifted so as to be very close to the glass and upon the edge of the platinum sheet. The intensity of the radiation per unit of surfaceswas increased thereby, according to the law of inverse quares, which seems to hold in this case. This use of the magnet is indicated in dotted lines and is very convenient for directing the cathode rays upon any part of the platinum anode: which anode might in fact be faced with a variety of different substances or have its surfaces differently formed, or curved at places while the cathode beam could be directed first to one part and then to another and the effects noted. If a platinum anode has been perforated by the beam at one point the tube is still useful, for a slight effect of the magnet puts the beam upon a new surface. Many a good tube may thus be made to do service even after several holes have been melted through the platinum sheet.

With such a source of rays as the tube, Fig. 1, it was easy to try an experiment, the result of which seems to the writer to leave no doubt of the fact that Roentgen rays, or rays of the same general characteristics, do actually cause the burns and injury which may follow prolonged exposures to the Roentgen radiation. The left hand was covered with a lead sheet of over 1-16 inch in thickness, and an oblong hole of about three-fourths of an inch long and about 5-16 inch wide cut through it at the part just over the third finger between the first and second joint. This limited the passage of rays to the part of the finger under the opening. But around the finger and under the middle of the opening was placed a strip of heavy tinfoil about 3-16 inch wide. This divided the exposed area into two parts. One of these parts in turn was covered with two layers of thin aluminum leaf gummed to the finger. Thus there were, in fact, three spots on the finger within the opening, one covered with aluminum foil or leaf, another with heavy tinfoil, and the third left entirely bare. The opening in the lead sheet was brought close to the platinum anode, Fig. 1, so that the finger was about 5-8 inch distant from the bombarded spot.

The exposure was for a period of twelve minutes, which it was thought would be sufficient. The result at first was two faintly reddened spots, one having the outline of the part under the opening in the lead shield covered by the aluminum foil, and corresponding thereto, and the other corresponding to the bare spot. Under the tinfoil strip there was no action. These reddened spots, though scarcely visible, could be developed by slight friction, but gradually faded until, at the end of a week from the time of exposure, they were with great difficulty distinguishable from the rest of the skin, even after the spot was rubbed. On the ninth day, however, they returned and the spots became painful and a little swollen. This has continued to increase and will probably end in blistering, sloughing and final healing. The part covered by the tinfoil is sharply marked from the others in being entirely unaffected. The effect produced through the aluminum leaf is about the same as on the bare spot, showing that thin aluminum does not stop the rays which produce harm.

FIG. 1



It is needless to say that the effect is proven by the experiment to be neither *electrostatic* nor *ozonic*, but merely a result of certain rays reaching the skin surface, and such rays are probably those of the Roentgen rays not readily absorbed. According to the law of inverse squares an exposure of twelve minutes at 5-8 inch distance would require at 10 inches distance, for equal effects, about 50 hours, or over two days. There is, then, no occasion for any alarm at the effects of Roentgen rays, as exposures of sufficient duration to produce harm are rarely if ever necessary. In regard to the claim which has been made that injury only follows exposures made by induction coils, while static machines do not produce the effect, it may be said that in the writer's former experiment, of which the little finger was made the subject, a large capacity static machine was used, and the result was severe enough. The present experiment was made with an induction coil as the source of electric discharges, and as yet there is no difference in the results. The effect is now, of course, limited to two small spots a little distance apart.

New Machine Put In.—The new Gamewell reporting machine has been placed in the City Hall, and it is one of the finest pieces of electrical apparatus ever installed in this city. The operating cabinet is of antique oak highly polished. The machine records by a typewriter arrangement the year, date, hour and minute the officer reports. The apparatus, while ready for work last night, was not put into active operation, but will be today, when all reports will be received over it.

Cochran, Ga.—Address clerk of town council concerning electric light plant complete.

TRACK AND TRACK JOINTS: CONSTRUCTION, MAINTENANCE AND BONDING.

M. K. BOWEN.*

(Continued from Page 220.)

PAVING: The road bed is now filled to within eight inches of the top of the rails with medium fine limestone, thoroughly tamped. Upon this place hemlock boards one and one-half inches thick, running lengthwise of the track. Upon this layer of boards a layer of clean sharp sand one inch deep is to be laid; upon this are to be laid the paving blocks, which should be No. 1 white cedar, six inches high. After being laid the joints are to be filled with good gravel or a limestone screening, tamped in place; the top of paving blocks to be even with top of rail both inside and outside.

GAUGE: The gauge must be four feet eight and one-half inches, or one-quarter inch wider than the gauge kept in the shop for gauging car wheels. This is important and should be closely watched.

LEVEL: There must not be over one-eighth inch difference in the height of two opposite rails. Any amount above this will be considered sufficient cause for rejecting such part of track and rebuilding or resurfacing the same. The foundation should be solid as possible to make it. The ties should be of such material that their life will be about equal to that of the rail; if anything, a trifle more. The expense of taking up and replacing pavement and repairing defective ties is very great. The wood most generally used, and the one which gives the best satisfaction, is good, sound white oak free from sap. Its life is about eight to ten years, under ordinary circumstances. The nature of the soil has considerable to do with the life of the tie. It is not good judgment to get the tie which will last the longest, thereby possibly paying a much higher price, for after the rails are worn out the tie will still be in a fairly sound condition, and the new rails may be laid on these old ties, which are fit to last only a portion of the length of time the rails will.

Brace chairs in place of tie rods cannot be recommended for use with high rails, as they are very apt to bend over in time, but with shorter rails this will not happen.

The paving of a street upon the right of way is generally regulated by municipal authorities. Wooden blocks are extensively used in the smaller cities, but in the larger ones they soon wear unevenly and require replacing. Granite block paving is by far the most durable, lasting under ordinary wear in cities thirty years, and should be used where the street traffic is at all heavy. The blocks should be hard, but not liable to become slippery by use, the average size being 4 x 8 x 12 inches. I advocate small blocks, even as low as 3 x 6 x 10 inches.

The cost of one mile of double track with paving for eighteen feet in width of right of way, as above specified, based on Chicago prices would be as follows:

283 l. tons 9 inch rails 90 at $33.00	$9339.00
4,224 white oak ties 5 x 8 inches x 7 feet at 38c.	1605.00
352 cast welded joints at $3.50	1232.00
1,760 tie rods at 15c	264.00
3,3792 spikes ½ x ½ x 4½ inches at 1c	338.00
42,240 feet of wooden filler at ½c	2112.00
Labor at $1.00 per foot of D. B. T.	5280.00
10,560 square yards cedar block 30c	3168.00
146 square yards sand at $1.25	183.00
445 cubic yards crushed stone at $1.50	668.00
10,560 square yards gravel and dressing at 8c	845.00
10,560 square yards hemlock boards 2 inches thick at 8c square yard	845.00
	$25,879.00

If granite had been used instead of wood block, the cost would have been $12,708.00 more.

(To be Continued).

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of the Institute held at 12 W. 31st street, March 24, a paper was presented by Dr. Karl E. Guthe on "The Imfluence of Heat Treatment Upon the Magnetic Properties of Hardened Steel." In the absence of the author the paper was read by Prof. H. S. Carhart of the University of Michigan, who took part in the discussion, together with Dr. Pupin and Mr. Winand.

At the meeting of Council in the afternoon the following associate members were elected—

ERNEST J. BECHTEL, superintendent power plant, Toledo Traction Co., Toledo, O.

ARTHUR HILLYER FORD, fellow in electrical engineering, University of Wisconsin, Madison, Wis.

HERMAN L. HOLBROW, with New York Telephone Co., New York City, residence Rutherford, N. J.

WILLIAM F. KELLY, student in expert course, Fort Wayne Electric Corporation, Fort Wayne, Ind

It was also decided to hold the general meeting of the Institute at Greenacre-on-the-Piscataqua, Eliot, Maine, beginning Monday, July 26. This date is the 50th anniversary of the entrance of the late Prof. Moses Gerrish Farmer into the field of electricity which became his life work. Prof. Farmer was one of the charter members of the Institute, and in consideration of his high standing as an original investigator and inventor he was elected an honorary member of the Institute Oct. 21, 1890.

His home during the latter part of his distinguished career was at Eliot, Maine, and he died at Chicago, May 25, 1893, where he had been engaged in the preparation of his personal exhibit at the World's Fair.

The council nominees for the Institute election on May 18 are as follows—

For President, Dr. Francis B. Crocker, of New York City.

For Vice-President, Dr. A. E. Kennelly, of Philadelphia, Chas. S. Bradley, of New York City, Prof. Dugald C. Jackson, of Madison, Wis.

For Managers, Dr. Alexander MacFarlane, of South Bethlehem, Pa., Gano S. Dunn, of New York City, W. F. C. Hasson, of San Francisco, Cal., Herbert Laws Webb, of New York City.

For Treasurer, George A. Hamilton, of New York City.

For Secretary, Ralph W. Pope, of New York City.

The officers whose terms have not expired are Vice-President Chas. P. Steinmetz, of Schenectady, N. Y., Prof. Harris J. Ryan, of Ithaca, N. Y., Prof. Wilbur M. Stine, of Chicago, Ill. Managers Chas. F. Scott, of Pittsburg, Bion J. Arnold, of Chicago, Carl Hering, of Philadelphia, Dr. Cary T. Hutchinson, John W. Lieb, Jr., and P. A. Pickernell, of New York City, Prof. Wm. L. Puffer, of Boston, and L. B. Stillwell, of Niagara Falls.

Ralph W. Pope, Secretary.

Ottawa, Ont.—The annual report for the Ottawa Electric Railway Company shows Ottawa's progress. The total number of passengers carried in the Ottawa electric cars in 1892 was 1,520,405, with receipts of $71,698. In 1896, the total number carried was 4,583,235, with receipts, $212,105.

Sherbrooke, Ont.—The Sherbrooke Electric Street Railway has let a contract for 500 poles, 200 of which the contractors will begin to deliver at once. The road to the exposition grounds will be finished for traffic by July, and the entire system in running order for August.

WIRING FOR LIGHT AND POWER.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The generation, transmission and distribution of power are problems that have occupied the attention and called upon the skill of engineers from time immemorial. There is every evidence to prove that some of the attempts made in early days were none the less worthy of the name of transmission plants than those of modern times—elaborate with improvements and bristling with devices for the safe transference of power.

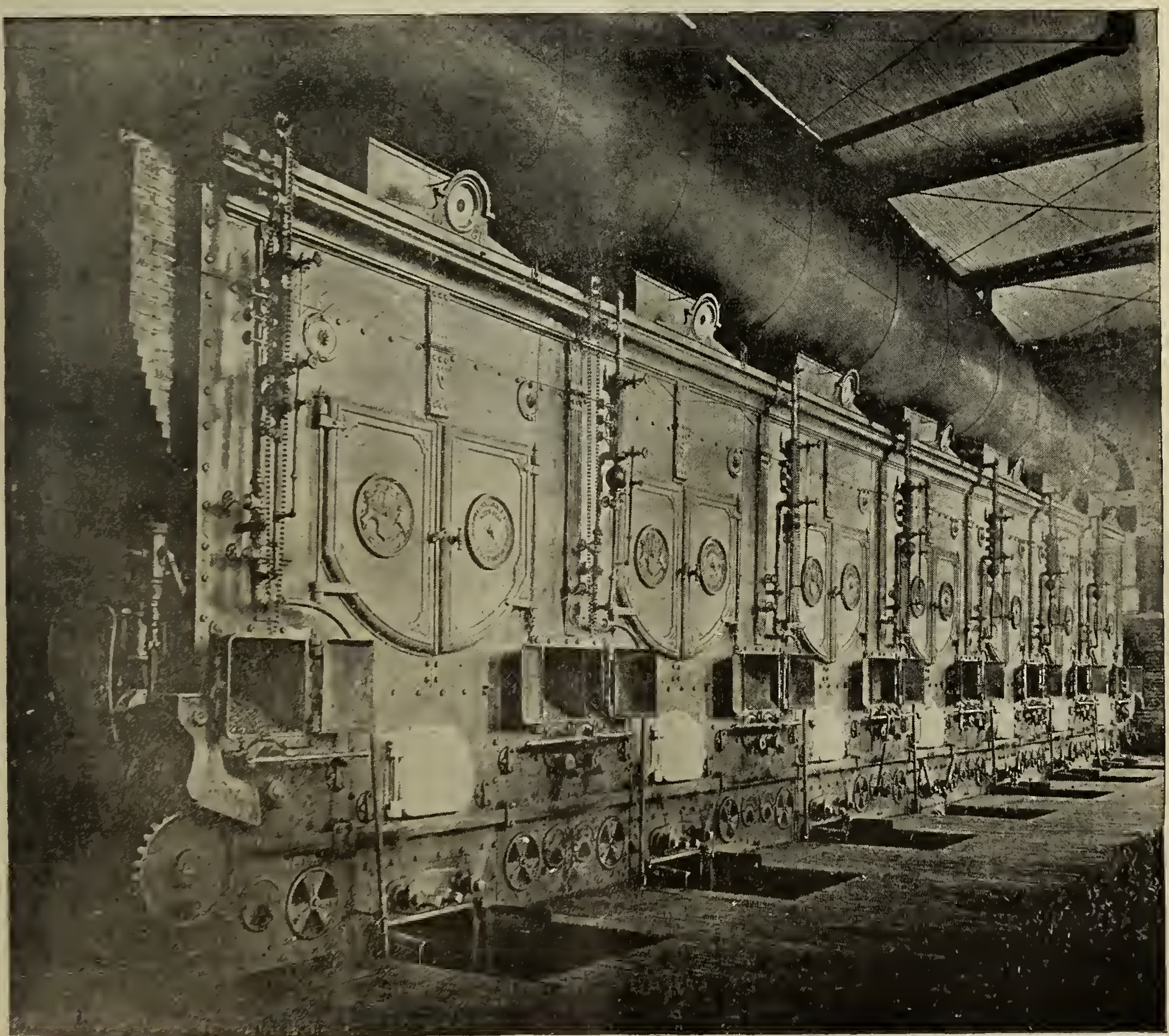
The transmission of power is merely the name for a system by means of which foot pounds of energy may be transferred from point to point conveniently and without much loss. Ultimately the power transmitted assumes the form of mechanical energy and is therefore to be looked upon as the result which, by its value in foot pounds, determines the superiority of one system over another. To speak of lighting and power circuits is simply to reconsider the conditions which, in a milder form, are met with when power is to be transferred. The generation of power may be carried on with alternating or continuous currents, but its transmission is not a problem of the same ease of solution.

Alternating Current Circuits.—The peculiarities of an alternating current manifest themselves very quickly under certain conditions. An alternating current is different from the continuous in one striking respect. It oscillates at the rate of perhaps 100 times a second back and forth in the circuit. Therefore if any retarding effect ensues it is likely to become highly developed and possibly so affect the line as to render ready transmission a matter of considerable difficulty. The *distribution* of power by alternating currents gives rise to certain other features of considerable interest to the reader. When power is ordinarily distributed we are not apt to consider the source of power, but merely the fact that it is to be sent from house to house as required.

When power comes from a long distance, the pressure of it is very much higher than it would be were it simply generated in the centre of a large city. The processes of transformation are more numerous in such a case than would be expected. The Ferranti system in London puts the current through two processes—

Generation at 10,000 volts.
(1) Transformation to 2,000 volts.
(2) Retransformation to 50 or 100 volts.

It is but necessary to understand that these changes only occur on account of the peculiar system in use, and not because the alternating current must be transformed.



Boiler Room of Central Station.

By continuous current the same kind of apparatus is used throughout. To reduce an alternating current either up or down requires the use of transformers. A continuous current can only be changed in pressure by means of motor transformers or storage batteries. To distribute either alternating or continuous current we are forced to use two entirely different systems. They bear a certain relationship, due to the fact that both are for the distribution of electricity, but in technical features they are entirely dissimilar. Power from either continuous or alternating currents means the use of special circuits, special motor and special precautions.

Continuous current circuits do not show other than the

most common features of distribution. A generating plant either employs dynamos for the distribution of light, or of both power and light.

The Edison Illuminating Company employs a special system or network of conductors. The current is generated at 110 volts pressure and two dynamos are connected in series for the purpose of supplying the outside line. This receives current at 220 volts pressure in consequence, but it has the added peculiarity of having three wires, between each two of which, that is to say, the first and second and the second and third, a dynamo is placed. Motors are fed from the two outer wires, which supply 220 volts, and lights are lit between the others. The insulation as well as the installation of continuous current lines is not in any respect complicated. There are several methods of conveying the current in actual use. But before this department of the work is considered, the fact that the wiring of a building and the system employed in having it reach the building are entirely dissimilar in certain cases may be realized.

Subways are used for the transmission of current from the station to the building. Upon reaching the house the paths the current enters into are those that lead to motors and lights. Usually the subway systems are made of iron pipes ending at the corners in manholes, bricked carefully and otherwise protected from the drainage of the neighborhood.

Both the alternating and continuous current people employ this system of pipe conduits, although in the case of the Edison Illuminating Company, where continuous current is used, the use of three wires introduces a feature which has made this system valuable to all large cities.

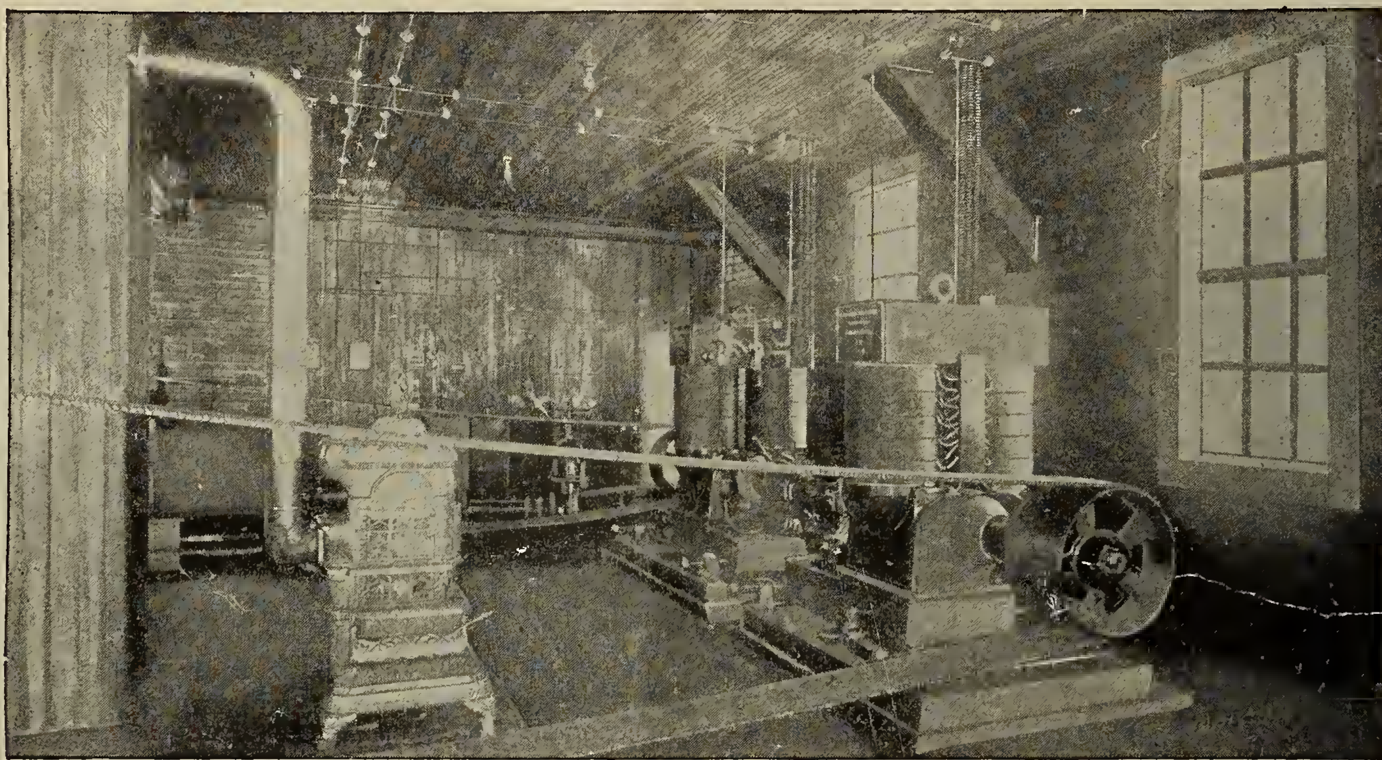
Balancing the load.—On account of the fact that three wires are used, the lighting occurs between either the first and second or the second and third wires. The general practice followed out by the Edison Illuminating Company is that of balancing the lamp load between these three in equal portions.

If 100 lamps are used between the first and the middle wire, to balance the line 100 lamps or their equivalent must be placed between the middle and third wire. The details of this system are quite interesting, as they exemplify the development produced by any departure from the ordinary in the pursuit of an improved method of distribution.

The Edison Company called the middle wire the neutral wire, beeause it is connected to both a positive and negative wire, which, however, belong to different dynamos.

Advantages.—Some of the advantages of this Edison network lies in its reduction of the drop of potential to almost a minimum and the saving of a fourth wire. Also in the employment of two pressures convenient for both motors and lamps. There are certain excellent points in the application of this system alike to both street and house, which have given it a permanent hold on the public.

The Edison network is built in such a manner that centres of distribution are supplied with wires which indicate at the station the exact pressure at that point. Each junction of conductors is kept at the same potential, as far as possible, as every other. The immense system of wires enables them to preserve an almost equable pressure at all times. It is worth noting that if the pressure supplied to the feeders running along the streets is 240 volts, the drop occurring in the line can be so limited that at least 230 is left. This will be sufficiently high to enable us to wire a building and still have a working pressure of 220 volts in the house.



Continuous Current Plant.

The problem of distribution consists in the preservation of the pressure at given points and not in the maintenance of it at a fixed pressure throughout. A station generating 100 volts may expect to lose 25 volts in the subway distribution, but it will be necessary for them to preserve the potential at the centres radiating to houses at a fixed value. If the allowance thus intentionally lost is premeditated, the new points in the street service from which the current is fed into the houses will remain at a constant pressure provided means are taken to effect the same. The value of a system depends upon the percentage of change going on; the less this is, the more life lamps will have burned on its circuits.

The distribution of alternating current could in certain respects be carried on the same as by continuous. The high pressure wires at 2,000 volts could lead to centres in the streets at which transformers could be placed and thus used as centres of distribution. The reduction of pressure from 2,000 volts need not be carried out in this case to less than 100 volts, and in this respect approach in technical detail the appearance of an Edison network as regards the centres of pressure and the wiring of the building.

Houston, Tex.—Address Alderman Street Council concerning proposed erection of electric light plant.

Bridgeburg, Ont.—A trolley line is to be built from Bridgeburg, the Canadian terminus of the International Bridge, to the gate of the new Fort Erie Jockey Club grounds, and thence on to Crystal Beach. It is expected to be completed and in operation before July.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—MAGNETIC SATURATION.

Auburn, March 31, 1897.

Electrical Age Pub. Co.

Dear Sirs: Kindly inform me whether it is necessary to confine the magnetic saturation of iron within certain limits in building heavy dynamos, and, if so, how this condition can be determined? If not asking too much, what metal is best for such purposes, i. e., cast iron, wrought iron or steel?

Yours respectfully,
Emanuel Pierro.

(A.)—The point of saturation is practically carried out to 16,000 or 17,000 lines of force per square centimeter, about 100,000 per square inch.

This condition is known and predetermined from the iron used, its dimensions, etc.

The general formula for all magnetic circuits is:

$$N = \frac{4 \pi n c \mu q}{10 l}$$

which can be likewise written:

$$N = \frac{4 \pi n c}{10} \times \frac{\mu q}{l}$$

or

$$N = \frac{4 \pi}{10} \times \frac{n c}{\frac{l}{\mu q}}$$

The best iron to use is wrought iron. The most popular metal to-day is cast steel (mild).

(Q.)—BACK E. M. F.

Baltimore, April 1, 1897.

Pub. Electrical Age.

Dear Sir: Can you tell me in untechnical language why the back electromotive force of a motor does not prevent it from running? Also how it is originated and its usefulness or injury to the motor.

By answering you will greatly oblige,

Yours truly,
Andrew McKenzie.

(A.)—The back E. M. F. of a motor is a little less than the pressure coming in from the line. The difference sends current into the armature. If the back E. M. F. were ever equal to that of the line the motor would stop. It is generated by the cutting of lines of force; the armature inductors revolving in the field, producing an internal and opposing pressure. It is an automatic regulator of the current, allowing it to increase when the load is heavy and to fall when light. The theoretical or electrical efficiency is determined by dividing the back E. M. F. by the applied E. M. F.

(Q.)—ELECTRIC LIGHT AT HOME.

Brooklyn, April 2, 1897.

Electrical Age Pub. Co.

Dear Sirs: Your interesting Inquiry Column has often given me the most valuable information on subjects I hardly knew how to inquire about.

I have been trying to equip my home with a few lamps run by batteries, but the results are not very satisfactory. Can you give me the assistance I need; that is, the battery to use and the kind of lamp?

Respectfully yours,
John R. Andrews.

(A.)—A battery for house lighting must be cheap and simple; the one that will comply with these requirements is a bichromate of potash cell. The carbon cylinder battery with a solution of bichromate of potash saturated, and having 10 per cent. sulphuric acid, will, if the zincs are well amalgamated, give a strong output. Use a 1-watt 8-c. p. 8-volt lamp.

Four of these cells connected in series will keep the lamp burning brightly many hours. The entire outfit costs less than $3.

A valuable and interesting handbook issued by the Standard Underground Cable Company is now ready for distribution. Its contents are of such a nature that a careful investigation of the same will be time well spent.

The present edition, No. XV., contains 182 pages and is an amplification of the No. XI. Handbook published in 1890, with necessary additions to bring contents up to date in every respect. From a perusal of the volume it is apparent that the purpose kept in mind in preparing this revised edition has been to give all useful information relating to electric wires and cables, and the installation of the latter, in as brief a form as possible consistent with a proper understanding of the subject discussed, and also to provide convenient rules, tables, etc., for ready reference and use by practical men.

The first 110 pages contain the price lists of all material sold by the company, with complete descriptions of all such articles in detail, and a handy telegraph code for the use of customers.

The question of electrolysis is thoroughly discussed in an article by the company's electrician, giving the results of actual tests made in the laboratory and in actual commercial practice.

Pages 111 to 126 contain complete instruction for installing all classes of cables and accessories, including conduit laying, cable laying and jointing, application of protective devices, etc., etc. Methods of testing cables, locating faults, etc., are carefully discussed and explained with diagrammatic figures in pages 137–142, and will prove valuable to those having such work to do.

The remainder of the book contains many tables of general and electrical information, the tables on pages 161–162 giving complete data as to the diameter, weight and resistance of solid and stranded copper wire, being especially accurate and more complete than any heretofore published.

The information contained on pages 173 to 176 on the "Effects of Alternating Currents" and "Changes of Electrical Properties with Change of Temperature" are of particular value at this time.

The general appearance of the book is very satisfactory, by reason of the neat binding and the high grade of the typographical work. The volume will make a valuable addition to any technical library, and its compact size renders it especially convenient for a pocket handbook.

It is issued in three styles of binding, namely: Morocco leather, with pockets, flap and gilt edges; green vellum, with pocket, flap and red edges, and brown vellum, with round corners and red edges.

More Electric Power on Steam Roads.—The 30-ton electric locomotive exhibited at Chicago in 1893 by the General Electric Company has been purchased by the Manufacturers' Street Railway Company, of New Haven, Conn., to haul freight cars from Cedar Hill, a point on the main line of the New York, New Haven & Hartford Railroad, one mile from the New Haven passenger depot, to the works of the Bigelow Company, the National Pipe Bending Company and other large manufacturers. The total length of the branch is nearly two miles, and the maximum grade 2½ per cent. The locomotive has a rated draw-bar pull of 7,000 pounds.

CANADIAN LETTER.

Richmond, Ont.—Tenders are being asked for lighting the town by electricity.

Huntsville, Ont.—Reeve Hutchinson interviewed the Commissioner of Crown Lands at Toronto last week with a view to expediting the passage of the bill to ratify the electric light and water works by-laws.

Ottawa, Ont.—The Bell Telephone Company, of Canada, under date of January 30th, has presented a petition to the Governor-General in Council asking for permission to increase its rates.

Raberval, Ont.—An electric light company is being organized here.

Rossland, B. C.—Messrs. J. R. Mitchell, of Vancouver, S. H. Webber, of Rossland, and P. C. Stoess, of Spokane, are applicants for incorporation as the Okanagan Water Power Company, with power to construct and operate a system of electric power and lighting plants at Dog Falls on the Okanagan River.

Victoria, B. C.—The following companies are seeking for incorporation: South Kootenay Water and Power Company, Revelstoke Water Works, Electric Light and Power Co., of Revelstoke, Fairview Power, Water and Telephone Co., and the Revelstoke, Trout Lake and Big Bend Telephone Co.

Fredericton, N. B.—The New Brunswick Telephone Company is extending its lines from Fredericton to Woodstock, along the St. John River.

Southampton, Ont.—Southampton has carried a by-law voting $11,000 for the purchase of the Saugeen water power and electric light plant.

Brookville, Ont.—Tenders will be received by J. W. Holmes, Clerk, at his office in the village of Dunnville for the lighting of the streets of the village by electric arc lights of 2,000 (nominal) candle power.

Chatham, Ont.—The Chatham City and Suburban Railway will apply for an Ontario charter to extend its lines to Rondeau, thence to Blenhein and Charing Cross, also to Wallaceburg and Petrolea.

Chicago money will build the Chatham City and Suburban line if the city will guarantee $200,000 of the company's four per cent. bonds for twenty years, in return for a lighting service of 100 lamps.

Richmond, Ont.—An electric railway scheme is on foot to connect Richmond and Bell's Corners, and to connect near the latter point with the proposed line of the Ottawa Electric Railway to Britannica. Power will be supplied.

Halifax, N. S.—The Halifax Tramway Company realized a profit of $27,000 in the last six months; a dividend was not declared. H. M. Whitney, president, and J. Y. Payzant and David McKeen were re-elected. The extension of the road was left over until the spring.

Chelmsford, Ont.—The Mineral and Timber Electric Railroad applies for an Ontario charter to build a line from a point between this place and Surgeon's Falls to Lake Wahnapital, and to James Bay on the North and Lake Huron near Killarney on the South.

Berlin, Ont.—There is a movement on foot to make the street railway the property of the municipality.

Peterboro, Ont.—The Peterboro street railway will probably be extended this spring.

Hamilton, Ont.—At a meeting of the shareholders of the Hamilton and Ancastor Radial Railway a resolution was passed to obtain the necessary powers from the legislature to extend the road to Brantford. The cost of the extension is estimated at $200,000.

ELECTRIC CABS RUNNING.

Electric cabs have come at last. Since Saturday the Electric Carriage and Wagon Company, which has its stable in Thirty-ninth street, just west of Broadway, has been running horseless hansoms. A special ordinance permitting horseless vehicles to run for hire in the streets has been signed by the Mayor.

At present only six of the twelve cabs that the company has are licensed, but many more are being made ready for use. The motive power consists of two 1½ horse power motors, attached to the front axle. The average speed at which they will be run is eight miles an hour, but they are capable of a speed of fifteen miles an hour, and tests show that they can run twenty-five miles without recharging.

While the officers of the new company predict that the motor vehicles will replace horses altogether by and by, they are not cutting rates. They say that a man can learn to operate their cabs in fifteen minutes.

NEW YORK ELECTRICAL SOCIETY.

The last meeting of the New York Electrical Society was held at Columbia University, Madison avenue and Forty-ninth street, on Wednesday, April 7, at 8 p. m.

Mr. E. E. Higgins, editor of the "Street Railway Journal," gave an informal talk on "A Resume of Financial and Engineering Practice in American Street Railroading."

The meeting was well attended.

George H. Guy, Secretary.

The Electrical Age.

VOL. XIX., No. 16. NEW YORK, APRIL 17, 1897. WHOLE No. 518

Fig. 1—New Factory of Tiffany & Co., at Forest Hill, N. J.

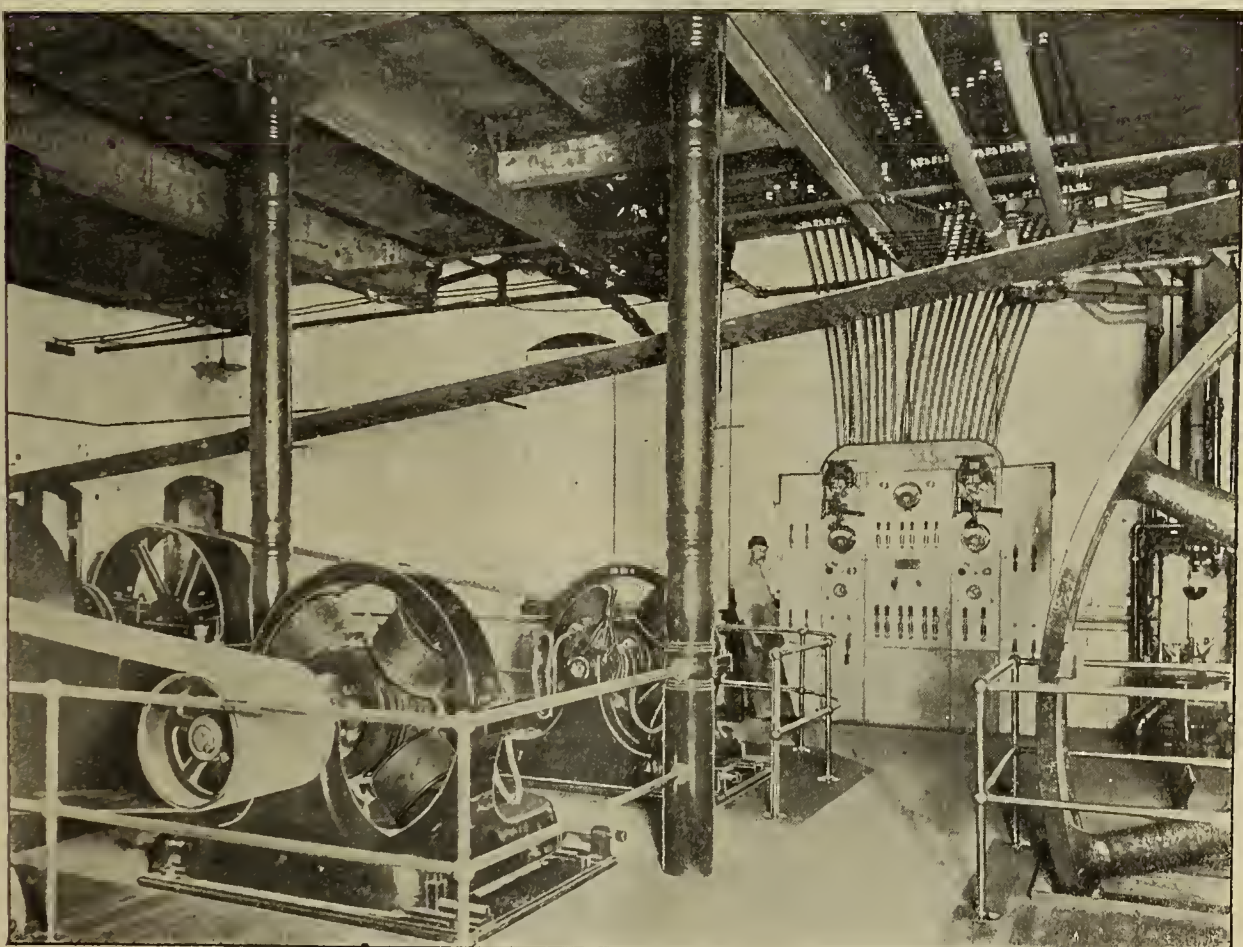


Fig. 2—Dynamo Room—Two 100-K. W., 250-Volt General Electric Dynamos.

ELECTRICITY IN THE TIFFANY FACTORY.

The famous silverware factory of Tiffany and Company, so long located in the heart of New York, has been removed to Forest Hill, N. J., where a new and spacious modern building has been prepared to receive this department of that great business, from which has emanated metal work of such a highly artistic character as to recall the glorious days of Benvenuto Cellini and the great artisans of the Cinque Cento. Here deft workers will handle the pale metal under better physical conditions, until it assumes the manifold forms of ornamentation from the simple expression of the decorative silver spoon to the intricate colored silver and enameled work which vies and rises superior to the creations of the best English and French silversmiths. This striking fact was acknowledged by the industrial and art papers of England and France, during the last two great French exhibitions, when Tiffany and Company secured the medal of honor—the highest award.

Tiffany and Company is an American institution, and in no way is this more forcibly demonstrated than in the practice adopted in that part of it now located at Forest Hill.

In this factory, everything with but few exceptions is modern—the building, the machinery, and last, and most up to date, the method of driving it. The entire steam engine plant is confined to one room, the power is distributed by electricity over a two-wire 250-volt direct-current system carefully laid out and as carefully executed. The entire electrical apparatus is of General Electric Company make, installed by its New York office, and is of the most recent manufacture.

The factory consists of a main front looking southeast

and three wings extending northwest, built of brick and stone, two stories high with a spired tower on the south corner. It is 350 feet long by 300 feet wide, and is divided into fifteen fireproof compartments.

The first wing running along the side of the Erie railroad and part of the front was constructed some two years ago. To this building was removed the plated ware department, the motive power for which was furnished by a 50-H. P. Ball and Wood engine. On the adoption of electric drive this was superseded by a 4-pole 50-H. P., 850-revolution motor.

The other two wings of the factory have been built during the past year and run parallel with the first, but are closed at the northwest end by the engine room, forming a large two story building around a spacious central courtyard. In this building the entire silverware manufacture of Tiffany & Co. is now carried on, under the superintendency of Mr. Parsell, to whose kindly courtesy we are indebted for the facilities extended on our visit to the works. This factory is the first instance, so far as we are aware, in the world, of a silverware factory operated entirely by electricity.

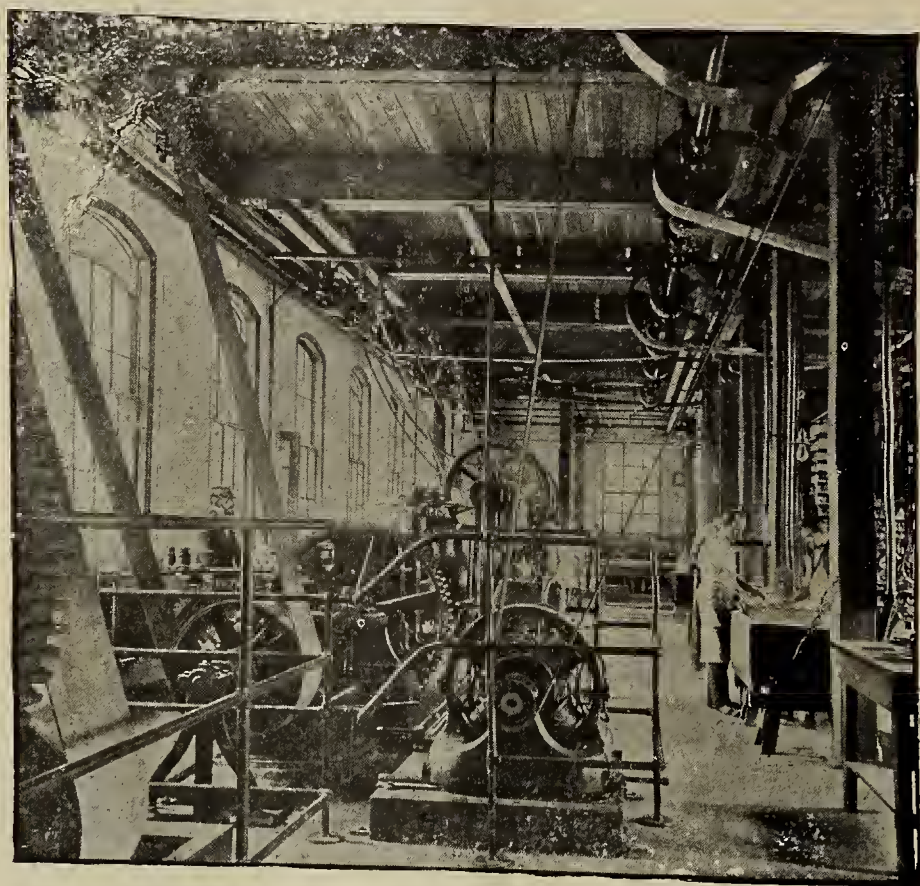


Fig. 3—Corner of Spoon-Making Room; One 20-H. P. Motor.

The description of this interesting factory must be limited to the electric drive installation. Time and space would not allow of an extensive description at this time of all the beautiful things made and shown our representative on his trip through the different departments.

The boiler room occupies a building by itself. It houses three 100-H. P. boilers built by Hewes and Philips, of Newark, 66 by 16 feet, with 96 three-inch tubes. Two of these boilers are in use; the third is held in reserve. The dampers are regulated by a damper regulator in the boiler room operated by the steam pressure. All the feed water is filtered through a Blessing filter, and a special meter is provided for any boiler trials that may be necessary. The boiler room also contains a Worthington fire pump of 1000 gallons capacity, connected to fifteen fire stations, one to each of the fireproof compartments. The steam piping is in duplicate, and is covered with Johns asbestos packing.

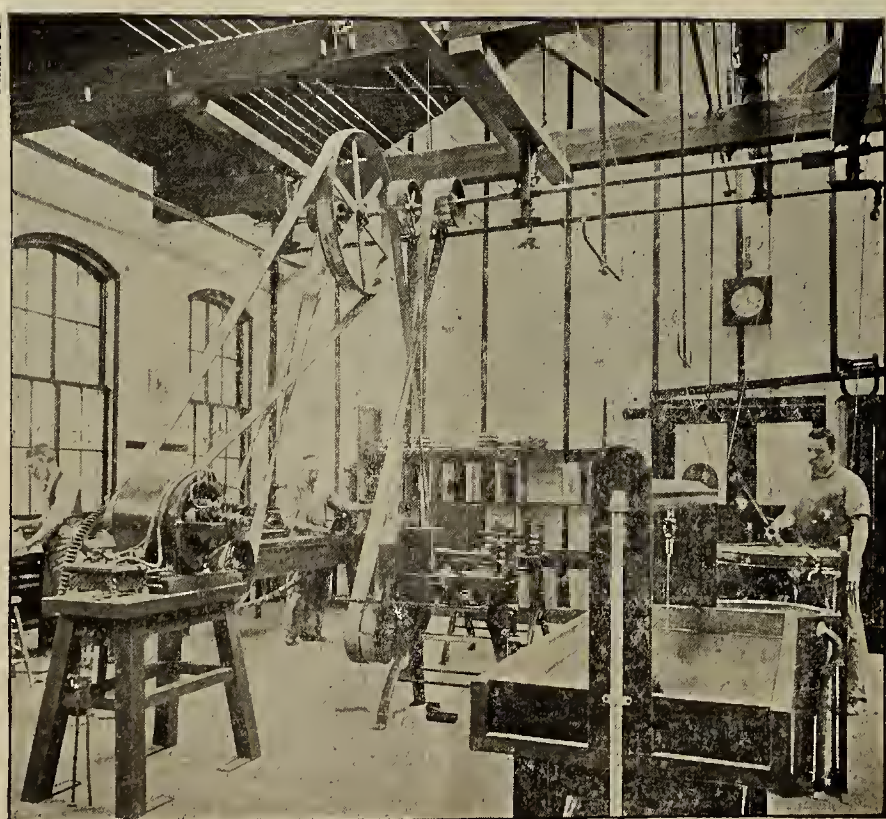


Fig. 4—Stock Room; One 2-Pole 5-H. P. Motor,

The water is derived from three sources: The public water mains, an eight-inch artesian well, 800 feet deep, and from the watershed of the factory itself. The courts

between the wings are arranged so that all the water falling on the roof and the yards drain into cisterns. One of 12,000 and one of 3,000 gallons are beneath the surface of the court between southern and central wings. Outside the works on the north is another cistern with a capacity of 70,000 gallons, and in addition there is a tank of 23,000 gallons capacity on the tower in the south corner, filled with water from the artesian well.

The spacious room above the boilers is the drying room, in which all lumber used in the manufacture of the cases for silverware and in work about the factory is dried. The boiler flues lead into a brick stack 100 feet in height.

By the side of the boiler room and in a room by itself is a Lidgerwood 30-H. P. steam hoist. This is put to a two-fold use. It hauls the coal cars from the Erie line along the siding running into the factory, and is connected to a bucket which lifts the coal from the car and dumps it into the coal bin. The capacity of the hoist for this work is 125 tons in seven hours. The coal is dropped by the bucket into a hopper leading to a gravity bin, the coal following down the inclined plane toward the coal doors in front of each furnace door. The under side of the inclined plane is used for the storage of all oils, spirits and inflammable matter, which are thus completely protected from any accident.

All the steam piping is laid in ducts, beneath the floors and courts. These ducts are covered by iron plates, which may be lifted at any point, allowing of easy access to any part of the steam piping for inspection or repair.

A covered passage leads from the boiler room to a handsome engine room, which is a model of its kind. The main engine is a 250-H. P., 490-revolution Corliss, also built by Hewes and Philips, of Newark. It is belted by a 28-in. belt to a countershaft running the entire width of the room, to which is also belted as an auxiliary the horizontal Ball and Wood engine of 50-H. P. This engine formerly drove the machinery in the plating department, but since this department was included in the electric drive scheme, the engine has been removed to the engine room proper. It will be used as an auxiliary in cases of light load when the factory is running overtime.

All the bearings are of the Hyatt roller type.

Standing beside the main engine is a Phole air lift, drawing the water from the artesian well previously mentioned, and a steam pump forcing it up into the tank on the corner tower.

The countershaft is equipped with Worrall cut-off couplings, by means of which either or both of the generators may be driven. To it are belted two G. E. moderate speed multipolar generators, each four-pole, 100-K. W., 750-revolution machines, delivering current at 250 volts. These generators are of a type which has recently come into extended use. The frames and pole-pieces are of

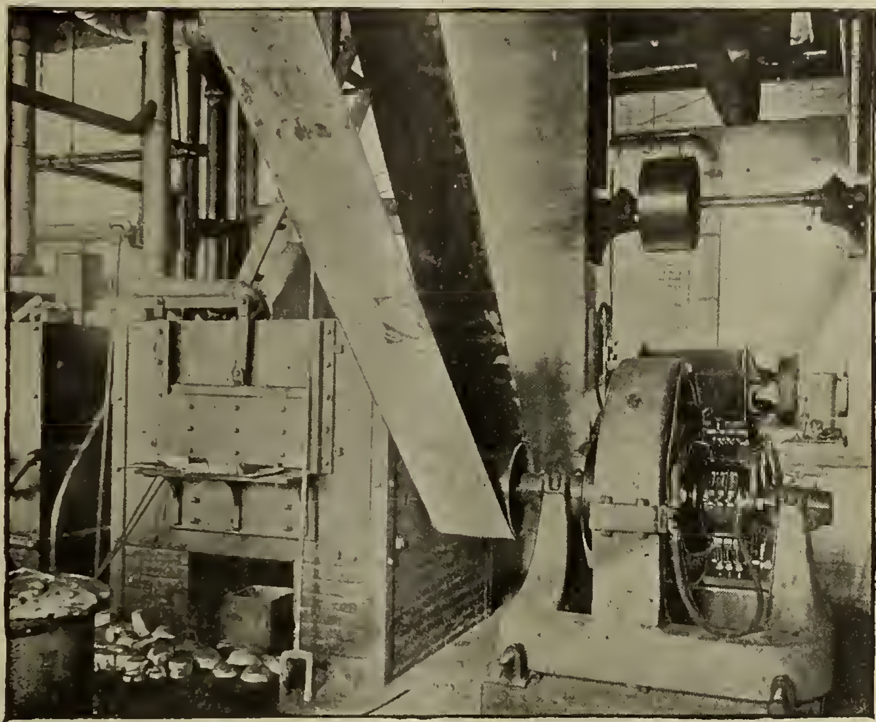


Fig. 5—Silversmiths' Large Work Room; One 2-Pole 3-H. P. Motor.

Fig. 6—Gilding Room; One 10-H. P. Motor and Plating Dynamo.

special, soft steel. The armatures provided with air ducts are thoroughly ventilated, and the coils of copper wire made on forms before being placed on the core are bound down solidly at both ends on cylindrical flange extensions of the spider. The bending of the armature coils is thus avoided and they can be removed and replaced easily and speedily. The insulation used is similar to that employed in the G. E. railway motors, and is both tough and impervious to moisture. The brushes are of carbon set in specially constructed holders, to give proper contact on the commutator.

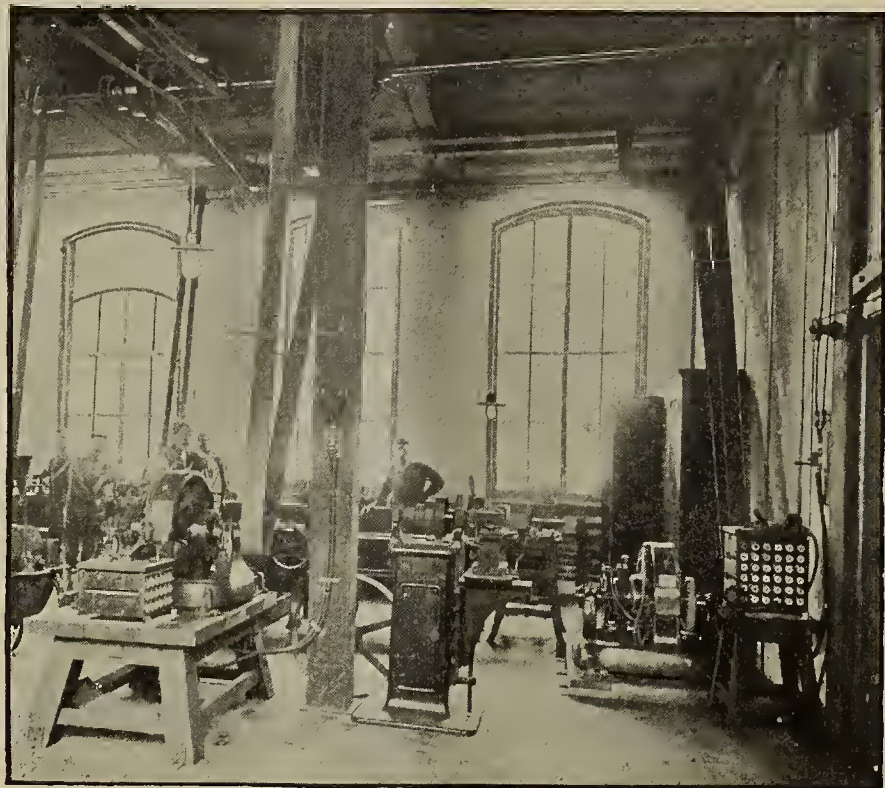


Fig. 7—Corner of Machine Shop; One 10 H. P. Motor on Stand and One 16 H. P. Motor on Floor.

The blue Vermont marble switchboard is composed of five panels. The centre panel carries a voltmeter and voltmeter switch, and twelve knife switches, six for the lighting feeders and six for the power feeders. The two panels on each side are generator panels, and each is equipped with ammeter, main switch, field switch, rheostat, pilot lamp and a G. E. automatic magnetic blow-out circuit breaker. The two outside panels carry four switches; on the right panel two for lighting and two for power in the case factory; on the left panel two for lighting and two for power in the plating department. All the switches are of the G. E. quick-break single-pole pattern.

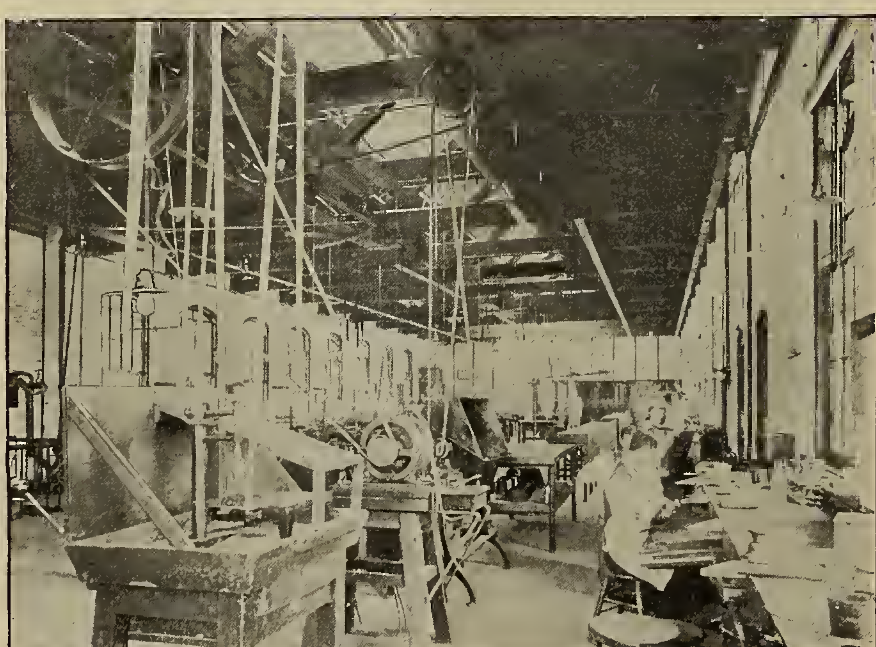


Fig. 8—50-H. P. Motor Driving Entire Plated Ware Department.

The leads from the generators are carried to the switchboard beneath the floor. From the switchboard the feeder circuits rise to the ceiling of the engine room, and, carried on porcelain insulators, in lines as straight as possible, pass to the various points of utilization in this interesting factory. In all passage ways on the floor of the engine room corrugated rubber is laid down, and all the machinery, both steam and electrical, is surrounded by polished brass railings.

The motor equipment consists of

3	I. B. Motors,	2 pole,	3 H. P.,	1,800 revolutions.
2	I. B.	" 2	" 5	" 1,700	"
1	M. P.	" 4	" 8	" 1,600	"
4	M. P.	" 4	" 10	" 1,350	"
3	M. P.	" 4	" 15	" 1,200	"
1	M. P.	" 4	" 20	" 1,050	"
2	M. P.	" 4	" 30	" 975	"
1	M. P.	" 4	" 50	" 850	"

allotted to the different departments and each equipped with incombustible starting rheostats with automatic switch.

The manufacture of the silverware may be said to start in a room on the first floor of the central wing, separated from the engine room by a driveway, and known as the smelting and refining room. This contains a cupola and cupel in which the refuse of the factory is treated. All the dust and refuse from the benches, floors and polishing tables is collected either by a powerful exhaust fan in a huge receiver or is carefully swept up and moulded into cakes, is introduced into the cupola and melted down. The hand washings are all collected into huge tanks and filtered to collect the metal dust. Nothing is wasted.

Every scrap of the precious metal is recovered and turned back into the factory.

Next to this is the moulding room, containing melting furnaces, casting machines, sand mills and boxes, etc. Here the casting is effected. This room contains a four-pole, 15-H. P., 1,200-revolution motor, belted to overhead shafting operating blast blower, moulding machinery, etc. In the next room, known as the stamping and rolling room, it drives a series of drop presses under which the silverware is stamped into the beautiful designs, which we recall on the mere mention of the name of Tiffany. This room also contains a large rolling mill, where sheets of silver one yard long and more, by two feet wide are rolled down to required thickness, toggle press and a hydraulic press of 1,000 tons capacity with its pump, all driven by a four-pole 30-H. P., 975-revolution motor, also belted to ceiling countershafting.

The next room occupies the remainder of the length of the wing and is known as the spoon-making room. Here the plain sheets of silver pass through the various processes to emerge in the shape of spoons of all patterns ready for the polisher's table. The heavy machinery in this room consists of two large rolling mills, the light of five presses, four spoon mills, four filing lathes, four drop presses, one shears, one saw lathe, one reversible mill and one burr lathe. All of this is driven by a four-pole, 20-H. P., 1,050 revolution motor also set upon the floor and surrounded by a brass railing. The only device not driven by electricity in this room is the steam hammer.

Mounting a spiral staircase in the corner of this room we emerge upon the second floor, and find ourselves in a large L-shaped room occupying almost the entire front and the southeast corner of the new building. This is devoted to the silversmith's small work, mounting, etc., and is driven by two motors, both mounted on small platforms. That in the long leg of the L is a two-pole, 3-H. P., 1,800-revolution motor; that in the short L is a two-pole. 5-H. P., 1,700-revolution machine. As its name indicates, the work done here is of a small character, and from this room emanate delicately-worked articles such as boxes, buckles, brushes, mirrors, and other articles for the boudoir, writing desk, etc. The greater part of the work in this room is bench work. The machinery driven by the smaller motor consists of emery wheels, burr lathes, drills, etc. That driven by the larger motor, one circular saw, one jig saw, one burr lathe and one turning lathe, one shears, one rolling mill and a grindstone.

The next room is the stock room, in which blanks are cut and wire drawn. This is equipped with a two-pole, 5-H. P., 1,700 revolution motor mounted upon a stand, driving a wire draw bench and five mills in which silver borders for teapots, coffee pots, cups, etc., etc., are rolled. This room is shown in Fig. 4.

Adjoining this is the spinning room, in which are eleven spinning lathes, three turning lathes, a large and a small circular saw, an emery wheel and a grindstone. All this is driven by a four-pole, 8-H. P., 1,600 revolution motor, set upon a low table and belted to the ceiling shafting.

The remaining length of the second floor on this wing is devoted to silversmiths' work. In this room, as in that given up to the silversmiths' smaller work, a great part of the work is done at benches.

The machinery is small and consists of two swedges, one saw and drill and one burr lathe. The motive power is a two-pole, 3-H. P., 1,800-revolution motor, mounted upon a raised platform.

Following this room is the gilding room, in which the machinery, consisting of three plating dynamos and two scratch brushes, is driven by a four-pole, 10-H. P., 1,350-revolution motor. One of the plating dynamos is a Wilde's machine, imported many years ago but still active. From this room entrance is gained to the etching, enamelling, and fancy-finish room. This room contains a series of polishing wheels, scratch brushes and drills, all driven by a four-pole, 10-H. P., 1,350-revolution motor. Here the exquisite enamelling and niello work is done.

The next room is the chasing department, in which, as the work is done by hand, no motor is required; and adjoining this is the engraving and die-sinking department, in which light machinery is driven by a two-pole, 3 H. P., 1,800 revolution motor. The balance of the second floor in that wing is the designing room.

Descending to the first floor, and passing through a door behind the engine room countershafting brings us to the machine shop, in which all machinery repairs are made. The machinery in this room consists of lathes, planers, shears, shapers, milling machines, cutters, etc., all driven by a four-pole, 10-H. P., 1,350-revolution motor shown in the illustration mounted on a stand and belted to ceiling countershafting. The motor shown set on the floor is a four-pole, 15 H. P., 1,200-revolution machine belted to a shaft running through the wall into the brushing and bobbing room. This room contains another four-pole, 15-H. P., 1,200-revolution motor, also belted to ceiling countershafting. From the ceiling countershafting two belts are brought down to shafting running beneath the brushing and bobbing benches. To the uninitiated "bobbing" is smoothing off irregularities on the silverware by means of a sea horse hide disk; "brushing" is the polishing operation after the silverware has been "bobbed."

At the side of the bushing and bobbing room is a small room containing a Sturtevant exhaust fan and an exhaust tank, a McKenzie blower and a large Root blower driven by a 4-pole 50-H. P., 975-revolution motor The exhaust fan draws all the dust from the brushing and bobbing tables into the tank, where it is collected for reduction in the smelting and refining room.

The polishing in the brushing room is the preliminary polishing of the silverware; from this room it passes to the finishing and polishing room., when the final polish is given to it. The rouge lathes are enclosed in a glass chamber and an exhaust opening faces each wheel. This department has a four-pole 10-H. P. 1350-revolution motor for its machinery, which in addition to the rouge lathes consists of a burnishing lathe, a grindstone and a scratch brush.

The last workroom of the factory is the repairing department, where all repairs to costly silverware, in many instances impossible to duplicate, are made. This is equipped with a two-pole five-H. P. 1700-revolution motor driving monitor and turning lathes, drills, saws and presses, emery wheels, etc. Through a window in the side of this room all the finished work is passed into the office, whence it is shipped to the store in New York.

The new building is lighted by 1190–250 volt 16-c. p. lamps; the old building or plating department by 199–250 volt 16-c. p. lamps, all furnished from the generators which supply the current for the motors.

Each separate department has a fireproof vault of its own, sometimes two, and a special office surrounded by a grating; nothing is left to chance, and every possible accident seems provided for in the scheme of operation. The sanitary conditions are perfect, and the buildings being built around a spacious court each room has windows on both sides affording petfect lighting and ventilation to the workmen, or rather the artists, the art feature pervading the whole establishment.

In addition to the factory proper, there are smaller buildings, the boiler room already described, a fire-proof vault standing in the court, and containing all the dies, chucks, patterns, etc., so indexed that any one can be found in one minute, and a gas works standing west of the first wing. For soldering and other purposes requiring great heat, glass blow-pipes are used. The gas for these is at present taken from the Newark gas mains, but Tiffany & Co. intend to manufacture their own gas as

soon as the gas works is completed, and have provided a large gas holder, which stands west of the boiler house.

The process of transfer of the silver manufacturing machinery from the old factory at Prince street to the new Forest Hill works is almost effected. As soon as the last piece is set up the work will be done, and the most efficiently equipped silverware factory in the world will be completed, a monument of progress and perfection.

MODERN OVERHEAD CONSTRUCTION.

BENJAMIN WILLARD.*

In the equipment of electrical street railways the item of overhead construction is a very important one, and one susceptible of many ideas. There are many different methods and kinds of materials used on overhead work, all of which would go to make up practical and modern construction; but, as a matter of fact, there are hardly any two installations which are near alike. The reason for such a variety of construction is naturally the results of engineers' ideas, conditions and opinions relative to the merits of different manufactured parts. It is hardly possible to standardize all methods and appliances in such a way as to meet the general approval of different engineers, as the requirements vary with local conditions, and what may be found practical in one locality may be found faulty in another.

Difference in local condition is not alone responsible for our inability to standardize construction and make it alike; it is because we are trying to arrive at a point of perfection and have a few miles to travel before we arrive there. The most practical method to pursue is to profit by the successful experience of others, and when we arrive at a point which we consider will admit of improvement, then put our individual ideas into effect.

There is room for the manufacturer to investigate more carefully the outside requirements and to make many materials which would find a ready market, whereas the engineer is now dependent on his ability to devise and utilize such materials at an exorbitant cost.

My ideas relative to what is necessary for practical modern construction will undoubtedly differ in many respects from the opinions of others, and in some instances may be found not practical, but experience has proven to me many important features to be observed in modern construction, and I can only submit what in my opinion and during my experience I have found to be substantially practical.

Trolley line construction can be erected in various ways and still conform to good practice, one difference being in the kind and cost of poles to be erected. There are various requirements governing the selection and kind of poles to be used which determine an important factor in the first cost. Municipal requirements may compel you to erect steel or wood poles, or you may be allowed to make your own selection. In the first instance the price is fixed and you have only one thing to do; in the second instance you have opportunities which are left for your own discretion. The steel pole presents a neat and attractive appearance, also taking up a small amount of space, which are the chief points in its favor. The insulating qualities are not as good as with the wood pole, and although I am not prepared to say positively as to its lasting qualities, I have made some observations of deterioration on wrought iron columns that have been in the ground for several years, and estimating that this deterioration would take effect in the same proportion on steel poles, I am convinced that in a moist climate a limit on the practical life of such poles would not be over thirty years. While I am not strictly an advocate of wood for poles, I am of the belief that from a practical and financial standpoint, wooden poles should be used in many instances.

Through the business sections of cities steel poles are in some respects better, as they are not affected by being wilfully or accidentally mutilated. In suburban or resident districts the wooden poles, when properly dimensioned, answer every purpose, and appear fully as well as the steel poles. A heart pine or cedar pole will, if properly selected and kept painted, last in some climates twenty years. This is a known fact from observation of poles that are now in sound condition after having been erected for that length of time.

Suppose we select New Orleans as a suitable location to build a road and base our estimates on cost of material there. The cost of steel poles would be greater than in many northern cities, owing to freight rates and distance from the manufacturers of such poles. Wooden poles can be furnished for less in New Orleans, owing to their near production, so that I think an estimate covering cost at that point would be a fitting proposition elsewhere.

Steel poles for one mile of span wire construction, 104 poles at $15 each, would cost $1,560, and assuming their life to be thirty years, the interest on your investment for thirty years at five per cent. per annum would be $2,340, or a total first cost and interest of $3,900. The setting of steel poles necessitates the use of concrete, which is an expense to be figured over the cost of wood pole-setting, so we must figure at least the cost of such material and labor which would be $4.50 per pole, or $468 per mile, and with interest for thirty years at five per cent. per annum, would be $1,170, or a total for interest and first cost of material and labor of $5,070, which is to be considered against the cost of one mile of wooden pole construction covering the same period.

Assuming the life of heart pine poles to be twelve years (instead of twenty years), I will base a comparative proposition on that basis, taking the interest on each investment and carry it through to the expiration of thirty years. Heart pine poles for one mile of span wire construction, 104 poles to the mile at $4.50 each, would cost $468, also suitable labor and material for erecting at $2.50 per pole, $260, or a total first cost of $728; to this must be added interest for thirty years at five per cent. per annum, $1,098, making the first investment at the end of thirty years $1,820. At the expiration of twelve years the construction must be renewed at a cost of $728, and to this must be added interest for eighteen years at five per cent. per annum, $655.20, making the second investment at end of thirty years cost $1,383.20.

(To be Continued.)

*Read before the American Street Railway Association, at the St, Louis Convention, 1986.

Chief Hale, of the Kansas City, Mo., Fire Department, has once more demonstrated his ingenuity by inventing an electric light for the buggy in which he makes his runs to fires, or perhaps more properly by fitting it with an electric light plant. The motion of the wheel when the buggy is moving propels a dynamo carried under the seat. This generates the electricity, and it is stored in a storage battery, which has no liquid in its composition and would not be affected by the jolts of the buggy. The storage battery has the capacity to keep two incandescent lights burning for four hours. The light may be turned on or off at will, but while they are in operation Chief Hale says there will be no danger of running into wagons or unwary pedestrians. This opens a field of great possibilities for all sorts of vehicles that travel at night and want strong lights.—The Fireman.

Salisbury, N. C.—City Commissioners may be addressed concerning establishment of electric light plant.

The Electrical Age.

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NEW YORK, APRIL 17, 1897.

CONTENTS.

THE UTILIZATION OF WATER-POWER.

We have repeatedly emphasized the great advantages of water-power in electric lighting and its allied branches. It seems that in the United States alone transmission plants have sprung up in centres devoid of fuel and owe their existence exclusively to some mountain torrent or hurrying stream. There are unwonted facilities at hand for the development of a lighing or power plant, provided water-power is within a moderate distance from some busy locality. In Switzerland, with its innumerable waterfalls, millions of dollars are saved and many industries strengthened by their use. Travellers report huge falls in the heart of Africa, which we doubt not will be used for some industrial purpose before many years have passed. Among the most noted may be recalled the Zambesi Falls, and along the famous Nile many an eddying rapid that has churned its way for centuries. It is strange to realize that fuel has been burnt with such prodigality in the past when at our very feet lies untold power. Many mines owe their present success to the fact that the resources in their neighborhood have been developed and used, and not the least important of these is some hidden torrent which bears within itself the mines very prosperity. Many experiments have been recorded of those whose efforts were bent in similar directions. The patent-office contains the specifications of many a wave and tide motor, the inventor keeping in view the vast quantities of energy going to waste at our very shores. Near Hell Gate, the East River runs with a velocity that would mean death to any but the strongest swimmer. It could deliver, during five hours of its flow, power to light Greater New York to its furthermost limits.

This is but one case in many that might be cited in illustration of the immeasurable force waiting our beck and call, but which passes by unused, and in fact too frequently forgotten. A calculation was once made by a scientist of the power represented by a year's fall of rain in any given locality. It exceeded a billion horse-power for the city of London alone. There is, of course, a limit to the practical value of these suggestions; yet, when the question of fuel consumption becomes a matter of serious consideration, there is not the slightest doubt but that the remedy will be found in some such source of power as the rain, the waves of the ocean, or the rising of the tide Our poor, puny coal fields with their countless tons of fuel are but one cipher in the vast figures which represent other equally useful power supplies. At the present rate at which the industrial world is growing we may fully believe that, in another fifty years, fuel will be consumed ten times as rapidly as today, and at a period not so far remote the burrowings and catacombs within the coal mines may be all that is left to remind us of what was once there. All estimates that have ever been made were based upon the present rate of consumption, but that is constantly increasing, and we may be forced to prepare for what England has already considered, exhausted fuel supply, unless independence is sought in those old stand-bys that can never fail us. Power will some day be sent inland from the coast, as it is now directed southward from Niagara Falls. There is every reason why capital and enterprise should investigate this subject with the hope of procuring thereby an industrial independence.

A NEW LIGHT FROM CALCIUM CARBIDES.

Washington, D. C., Feb. 9, 1897.—Hon. George Sawter, United States Consul at Glauchau, Germany, has forwarded to the State Department the following report on a new light from calcium carbide.

The development of the lighting industry is going on at a most rapid and steady pace of late in Germany, particularly as regards the manufacture of calcium carbide for the production of acetylene, the new illuminant, a discovery which has been greatly experimented with and discussed everywhere during the last few years. Considerable data are available regarding it, so that the inquiry which has been made and published as to its history and value as a practical illuminant has been of world-wide interest. While all this has been in progress, another new composition in the field of illuminants has appeared on the scene in the shape of a calcium carbide for the purpose of illumination.

This object can be obtained in the most perfect manner by heating a mixture of the earth-alkali-metal oxides, or earth-alkali-metal carbonates, and similar substances, with carbon in a furnace, by means of darting flames, which flames are to be produced in unlimited number through acetylene or other gases, kept under pressure. By the generating temperature, the product in the furnace is made liquid by means of the darting flames, and yields, after cooling, a crystalline mass, which consists of the carbides contained in the metals of the mixture used. If certain parts of calcium oxide are used, and certain parts of carbon, the result is a calcium carbide, which in consequence of the cheap producing process, especially for illuminating purposes, may be used with advantage. This shows that by means of the preceding invention from a commercial standpoint, in the cheapest ways, great quantities of acetylene may be obtained, and since the same when heated results in polymerisms. Thus the many ways of employing these bodies must be regarded as extraordinary manifold.

Ingersoll, Ont.—The Ingersoll Radial Electric Railway Company which is seeking incorporation, proposes to construct an electric railway from Ingersoll to St Mary's, Tillisburg, Brounsville, and other towns. Stock $500,000.

THE INFLUENCE OF HEAT TREATMENT UPON THE MAGNETIC PROPERTIES OF HARDENED STEEL.

BY DR. K. E. GUTHE.

(Continued from Page 211.)

Chemical Analysis.—the chemical analysis of the rings gave the following results:

	Ring I. Crescent Steel	Ring II. Basic Steel	Ring III. Very Soft Steel	Ring IV. Swedish Iron
Carbon	.868%	.309%	.0755%	.144%
Silicon	.234	.025	.0155	.0624
Sulphur	trace	.059	.0645	.015
Phosphorus	.0172	.146	.124	.018
Manganese	.27	.78	.36	trace

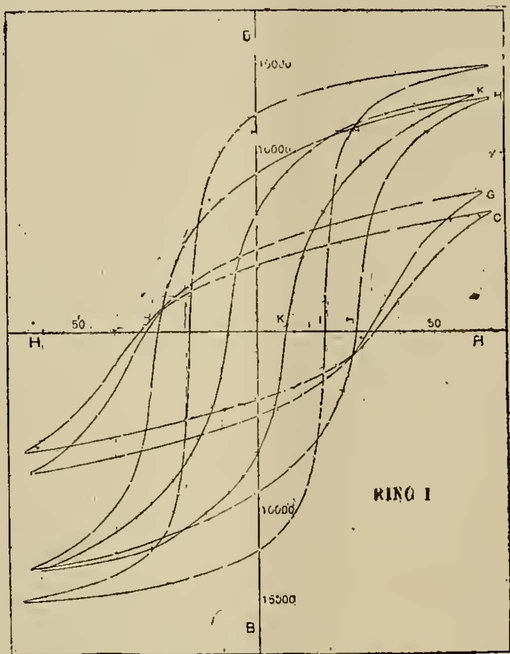


PLATE 1.

For the chemical analysis and the heat treatment of the rings I am indebted to Prof. E. D. Campbell, director of the metallurgical laboratory, and his assistant, Mr. A. R. Miller. I gladly express my deep obligations to them, especially to Professor Campbell, who devised and superintended every particular of the complete heat treatment.

The rings were first heated in the original state and then subjected to the heat treatment. The different steps taken are the following:

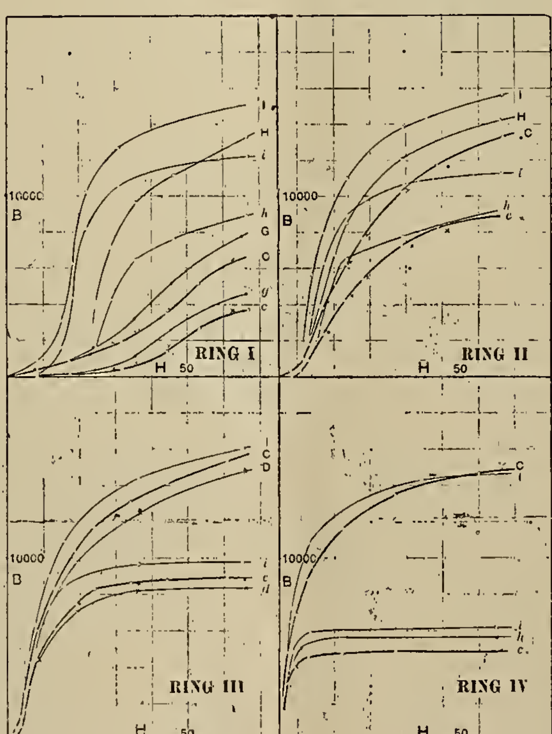


PLATE 4.

A. Rings in the original state.
B. Heated to about 670° and quenched.
C. Heated to a little over 900° and quenched.

The hardened rings were then tempered by reheating to the temperatures indicated below, and then allowed to cool slowly. D, 100° for one hour; E and F, 100° for 24 hours; G, 200°; H, 300°; I, 450°; K, 800°; L, (only for rings II. and III.), about 950°.

RESULTS.

A. Rings in the original state.

The measurements of rings gave the following data:

	Ring I.	Ring II.	Ring III.	Ring IV.
Mean diameter	12.607 cm.	12.699 cm.	12,63 cm.	12.607 cm.
Volume	95.099 cm³	80.637 cm³	109.29 cm³	107.99 cm³
Cross-section	2,401 cm²	2.021 cm²	2.754 cm²	2.727 cm²

As I stated before, these measurements were repeated every time after the rings had been subjected to a high temperature, so after the following steps: B, C, K and L. Each time a small decrease of the cross-section, was observed.

In the original state, the hysteresis curved for only one maximum magnetizing field (H) of about 60 were determined, except for Ring I, for which the value of H was varied. In the following tables n_T designates the number of primary turns, c the deflection of the galvanometer, obtained by the discharge of a capacity equal to .2 microfarad charged by a Carhart-Clark standard cell, d the deflection of the galvanometer due to the change of the lines of magnetic force in the ring, B the calculated value of the induction, I the current in the primary measured in amperes, H the value of the magnetizing force.

It will be noticed that I give only the values of B and H for one side of the hysteresis curves. Since the same steps were taken on the ascending and descending branch

of the loop, the values were generally identical, and are therefore not recorded in the following tables, though the whole cycle was taken in the actual experiments.

The hysteresis curves show strongly the influence of carbon, the area of the loops diminishing with the decreasing percentage of carbon. The mild steel shows, indeed, a curve very similar to that of wrought iron. The maximum induction, taking the rings in the order I, II, III, has the values: 13840, 15070, 15290 lines of magnetic force, while the magnetizing force was very nearly the same in all cases. The corresponding coercive forces are 8.6, 2.7 and 3.6.

B. Rings heated to 675° and quenched.—The rings were then introduced into furnaces, which were well heated beforehand. On the bottom of the muffles was put a sheet of asbestos and over this two strips of the same material, on which the ring was placed. In order to prevent oxidation as much as possible, charcoal was put in the opening of the muffle. The heating to a dull cherry red took about eight minutes. Then the ring was withdrawn quickly and quenched in water at 5° C

Ring I has become magnetically harder, i. e., the maximum induction for the same magnetizing field has decreased, the permeability, especially for low fields, is smaller, and the coercive force is increased to more than twice its original value.

The iron ring shows an increase in permeability, which may be explained by a previous mechanical hardening, when it was turned to its proper shape.

In rings II and III there is no sign of magnetic hardening, the principal influence of this treatment being the remarkable drop of the remanence, while the maximum induction remained almost unchanged. The permeability, on the other hand, decreased a little. This sudden and unexpected drop in retentivity will again be met later on and discussed there more fully.

It is apparent that we have not passed the temperature at which low carbon steel is hardened. It is well known that the second and third point of recalescence for low carbon steel lies at a higher temperature than the corresponding point in the high carbon steel, which apparently had already been passed in the case of the high carbon steel. It is, therefore, probable, though I do not consider this experiment as an absolute proof, that the magnetic hardening takes place when steel is quenched after it has been heated to the same temperature at which recalescence occurs, i. e., the critical temperature at which, according to Hopkinson and others, iron loses its magnetic properties.

C. Rings heated to a little above 900° and quenched in ice-water of 5°.—The heat treatment was the same as in B, but the temperature was raised beyond the third point of recalescence of the low carbon rings.

All the steel rings show the hardening effect, the same being the smaller the less carbon the steel contained.

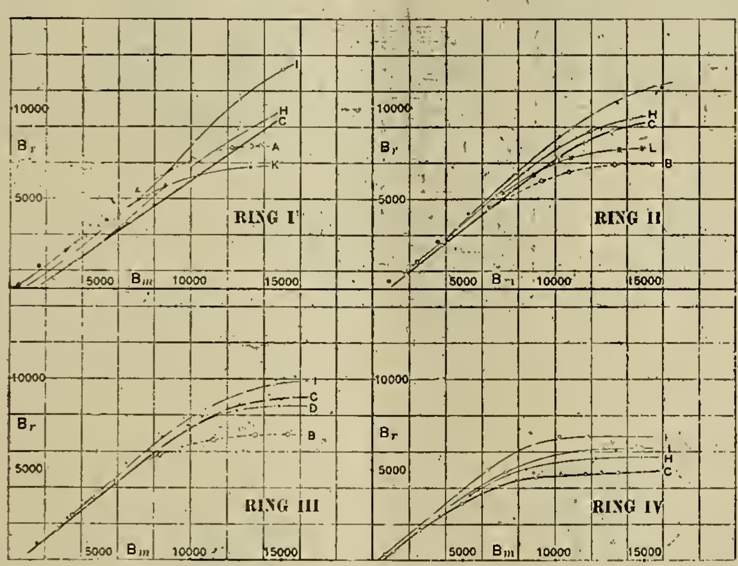


PLATE 5.

The high carbon ring (1) shows a decided increase in the hysteresis loss, which is much greater than the increase due to the first heating. While the first time the temperature was raised only a little beyond the point of recalescence, it was this time at least 250° higher. We draw therefrom the important conclusion that steel becomes magnetically the harder, the more the temperature is raised beyond the recalescent point. The passing of this point by only a few degrees is not sufficient for the maximum effect.

(To be continued.)

NATURE-STUDY FOR PUBLIC SCHOOLS.

Nature study, or seeing familiar things in a new light, is a valuable factor in education. How many people can explain, so that a child can understand, why water puts out fire, why some young squash plants bring their shells out of the ground on their backs and others do not; or show the differenee between a leaf bud and a fruit bud of the apple; or tell from whence all the house flies come? The world is full of such common things, about which people do not inquire. Yet such subjects can be made very interesting to children, and they can be taken up in the schools, not as an added recitation, but as a rest exercise once or twice each week to relieve the monotony of the school room, and later be made the theme for a language exercise. Here are two important faculties that may be brought into exercise—accurate observation and the power of expressing definitely what is seen.

The College of Agriculture of Cornell University has, under the Nixon or Agricultural Extension bill, undertaken to assist, free of expense, all teachers who wish to introduce this work into their schools. All parents and teachers interested in this work are asked to send their address for more detailed information to

Chief Clerk, College of Agriculture,
Ithaca, N. Y.

(Q.)—TRANSMISSION OF IMAGES BY ELECTRICITY.

The Electrical Age:

Dear Sirs—Have images ever been sent over a wire by electricity?

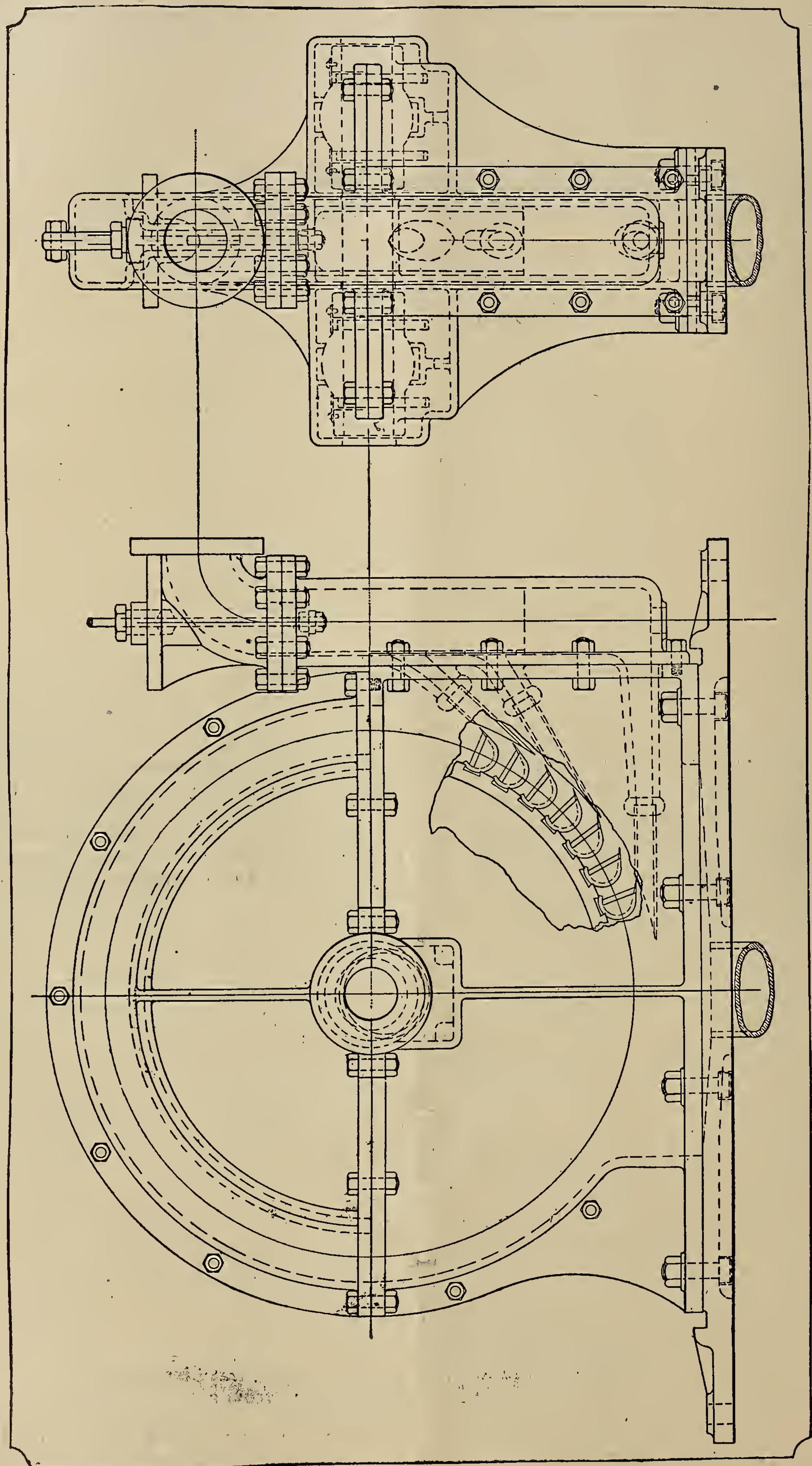
Yours respectfully,
I. N. Quiry.

(A.)—Images have been sent over a line, but with very little success from a general or practical standpoint.

MR. W. C. ARMSTRONG is an excellent salesman as well as an electrician of ability. The Peck Electrical Company should feel proud to have so practical a man on their staff. Mr. Armstrong sells the Helios arc lamp for the Peck Electrical Company, No. 15 Cortlandt street, New York.

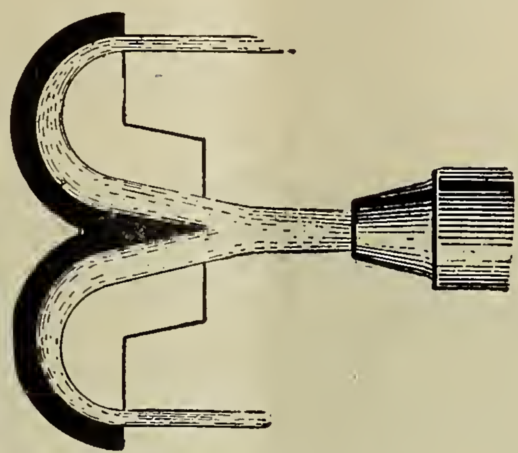
THE "CAZIN" POWER WHEEL.

The use of water-power has opened up new fields to the engineer and capitalist. Transmission plants are heard of on all sides, whose primary function is that of transforming water-power into useful mechanical energy. Many mines rely entirely upon their water supply for power and only operate economically under such conditions. The selection of a water-wheel which represents the use and not the abuse of a principle requires considerable judgment. The American Impulse-Wheel Company, 120–122 Liberty street, New York, under the patents of F. M. F. Cazin, their consulting engineer, manufacture a water and steam wheel which will run the gauntlet of scientific criticism unscathed. The condition of maximum efficiency, according to such eminent author-



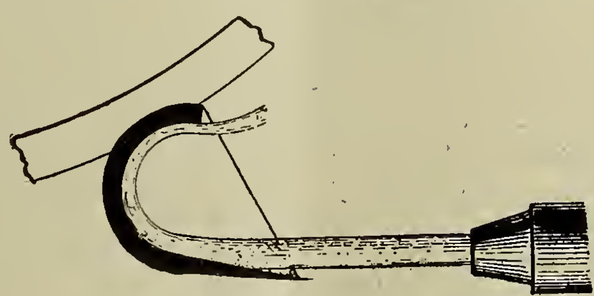
The Cazin Wheel in its Standard Form.

ities as Weisbach, Bodmer, etc., is that in which the water leaves the face it strikes against in inverse direction to the direction in which first contact was made. This idea had been crystallized by Cazin in the construction of a vane against which the striking water will elastically recoil, leaving it in an opposite direction to that of the



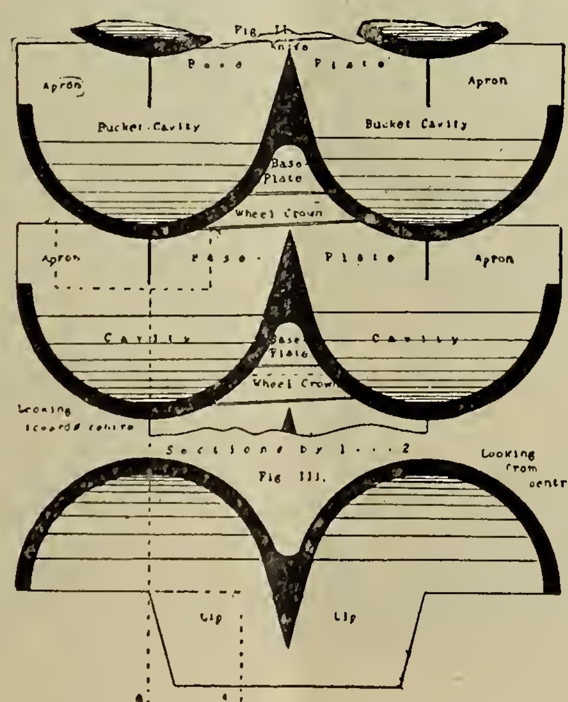
Section of the Cazin Vane.

impact. The ingenious shape of the nozzle mouth with its outlet close to and tangent to the path of the vane removes the objection to a nozzle whose distance from the vane when delivering water would cause loss of power. In the illustrations these scientific points are well represented. The stream of water striking the curved vane,



Section of the Cazin Vane.

its circular path and reversion are beautifully set forth, appealing alike to reason and experience. Likewise the position of the nozzle and its oval outlet, which embodies the principle of economical delivery, the water entering the vane directly from the pipe. A pair of buckets and a drawing which illustrates the general construction of



Transverse Sections of Pairs of Buckets of the American Impulse Wheel.

the wheel is shown in addition. The three nozzles playing upon the vanes are shown as in the actual wheel. In the use of a "Cazin" free-jet wheel instead of an immersed turbine there is no loss of head, the impulse-wheel having, in fact, a higher efficiency. Repairs or renewals are easily effected of either vanes or blades. It seems therefore, from this hasty resume of the qualities of this wheel, that no objections exist which have been items of prejudice in the past and which still exist in the wheels of other manufacturers. The book descriptive of the "American" Impulse-Wheel, some discoveries and inventions of F. M. F. Cazin and certain other valuable tables, data and so forth, may be obtained on application. The invention of F. M. F. Cazin is for sale by the American Impulse-Wheel Company, whose address as before noted is 120–122 Liberty street, New York.

Albany, N. Y.—The Columbia County Electric Co. bill to incorporate the same has been introduced in the Senate. The object of the eompany is to build three dams along the Kinderhook Creek, in Columbia County, one at Valatic, to have a fall of 75 feet, another at Stuyvesant Falls, and the third at Stottsville. The three dams will gather water with which electric power will be generated to supply all applicants, and pure water also be sent to towns throughout Rensselaer and Columbia counties. The sum of $500,000 it is estimated will be expended by those having the scheme in charge. The company will probably be capitalized at $10,000,000.

Norfolk, Va.—The Norfolk Light and Power Company has been incorporated by William Roseborough, president; W. H. Minor, vice-president, and A. E. Krise, secretary; to furnish electric lights, etc.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—IMPEDANCE.

San Antonio, April 3, 1897.

Electrical Age:

Dear Sir: Having frequently noted interesting answers in your Inquiry Column to questions asked, I take the liberty of joining the ranks of "quizzers" and beg an answer to the following: When an alternating current passes through a coil and is reduced thereby, is there any expression, mathematical or otherwise, by which the conditions affecting the volume of current may be explicitly stated?

Yours respectfully,
R. L. Sanger.

(A.) A coil has
Resistance and
Self Induction.

When a sine wave of current passes through it with a given frequency the opposition within the coil or "impedance" is written as $\sqrt{R^2 + p_2L^2}$

where R = resistance,
L = self induction,
p = 2π n, in which n = frequency.

The volume of current passing is equal to the electromotive force divided by the impedance.

(Q.)—MAGNETIC FRINGE.

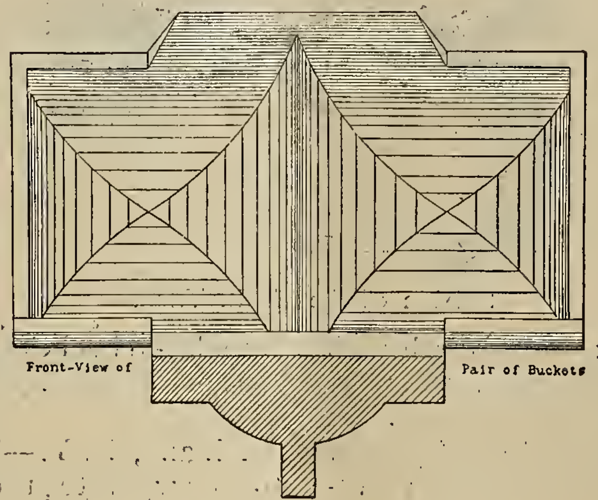
Schenectady, April 8, 1897.

Electrical Age:

Dear Sirs: If the answer to this question is not too much involved in complexities beyond my limited power of comprehension, I would like to know what is meant by "magnetic fringe." It is used in certain cases to effect the generation of E.M.F. or, at least, I judge so from the little I know.

Yours truly,
Albert Shepard.

(A.)—By magnetic fringe we mean the lines of force that spray from the edge of the pole-piece (parallel to the shaft) into the armature. A magnetic fringe is necessary for the purpose of securing sparklessness. The armature coils have each successively set up in them inductive action, which is annulled by this thin fringe of lines of force.



Pair of Buckets. (See Page 251.)

(Q).—BURNS FROM HOLTZ MACHINE.

New York, April 10, 1897.

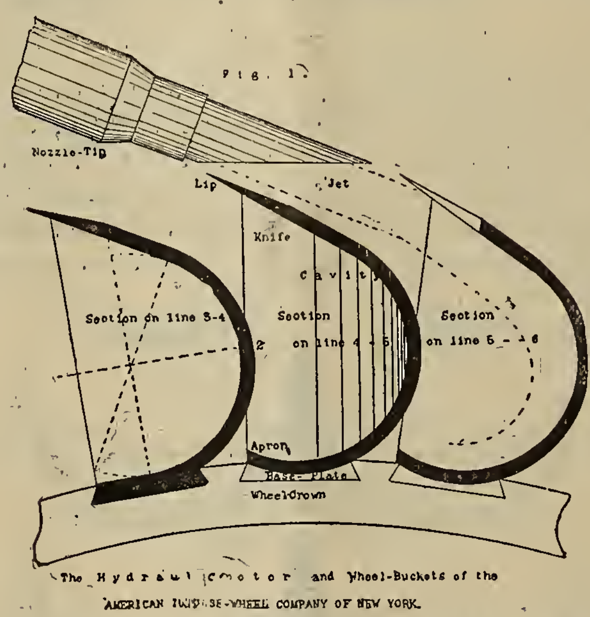
Ed. Electrical Age:

Dear Sir: I have just noticed in the columns of your most valuable paper that burns occur from X rays produced by the Holtz machine.

I have used mine frequently for that purpose and not experienced anything as described by Elihu Thomson.

Yours,
A Subscriber.

(A.)—It seems that the sum total of experience indicates the eventual presence of burns as described, after exposure to X rays. Whenever they are produced by a powerful source of energy, such as a Ruhmkorff coil or large static machine, burns appear on the flesh of those experimenting without the proper precautions. The burning may be due to some influence only *associated* with X rays under certain conditions; but of this, however, nothing can be definitely stated.



The Nozzle of the Cazin-Wheel. (See Page 251.)

Rock Rapids, Iowa.—J. K. Medbery, Recorder, may be addressed concerning installation of complete electric lighting plant.

WIRING FOR LIGHT AND POWER.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

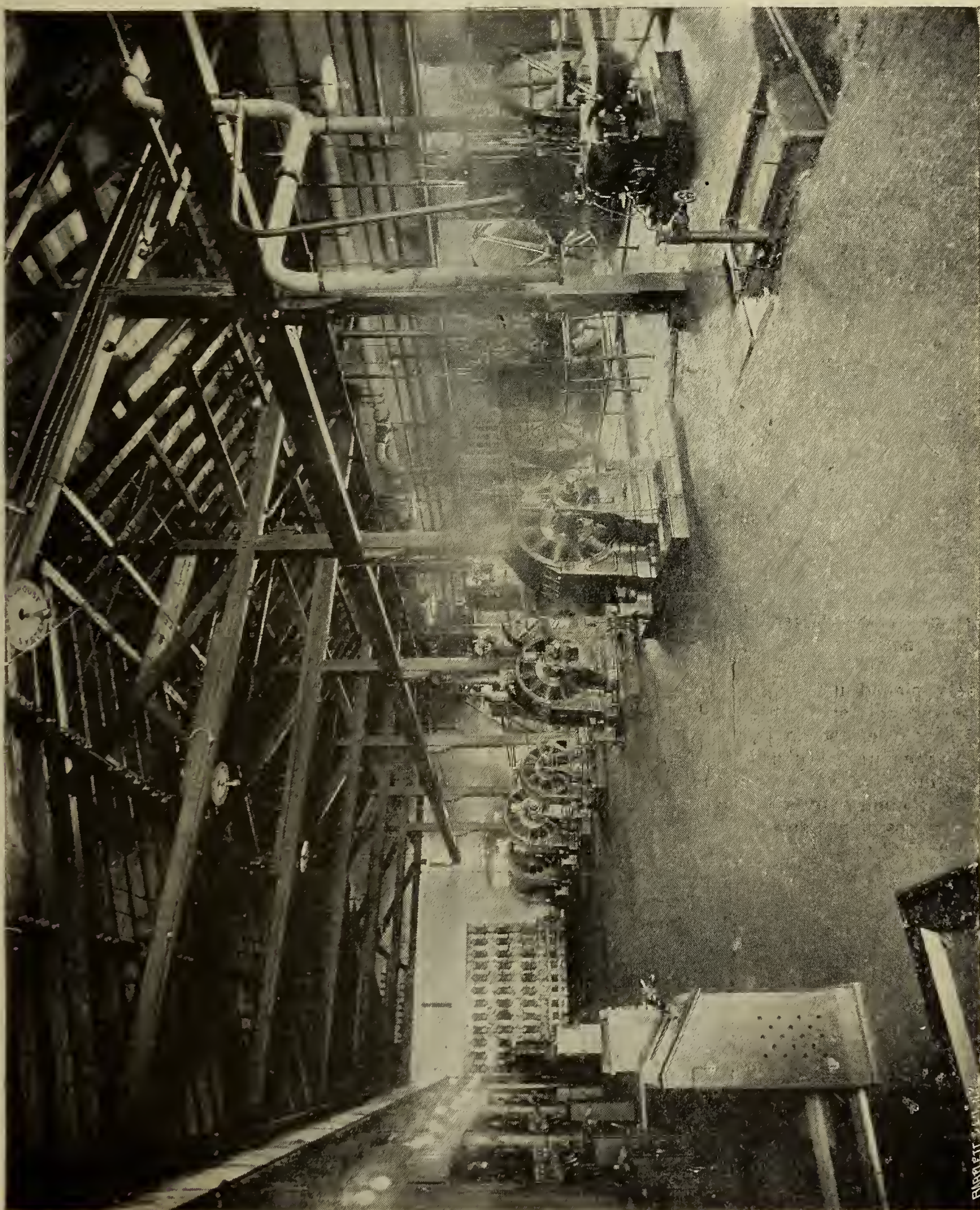
The wiring of buildings is the ultimate final of a street subway system. The current is generated in a central station, distributed either as an alternate or continuous current through the streets in conduits specially prepared and then connected to the wiring circuits of any large house, hall or public building.

This entire city is completely enclosed by a network of underground wires, each insulated from the other and proportioned in size so that the proper pressure and current is delivered at the door of every consumer's house.

The control and care of a subway system is in itself a duty of a most important character.

There is a likelihood of several kinds of trouble developing. Each must be discovered and treated in a manner sufficient to remove either itself or the cause as speedily as possible. There is every means observed on the part of central station managers to take the most jealous care of their subways. It is in the perfection of these and their freedom from faults that the profits of the plant mainly lie.

The wiring of a building can therefore be regarded as the final outcome of an elaborate equipment composed of



Alternating Current Station and Switchboard.

(1) A central station plant.
(2) A subway or distributing system.

The main points to be considered in the construction and maintenance of an electric light system, with special reference to the lines, either inside or out, are

Freedom from grounds.
Freedom from short circuits.

A series of less important troubles are constantly devel-

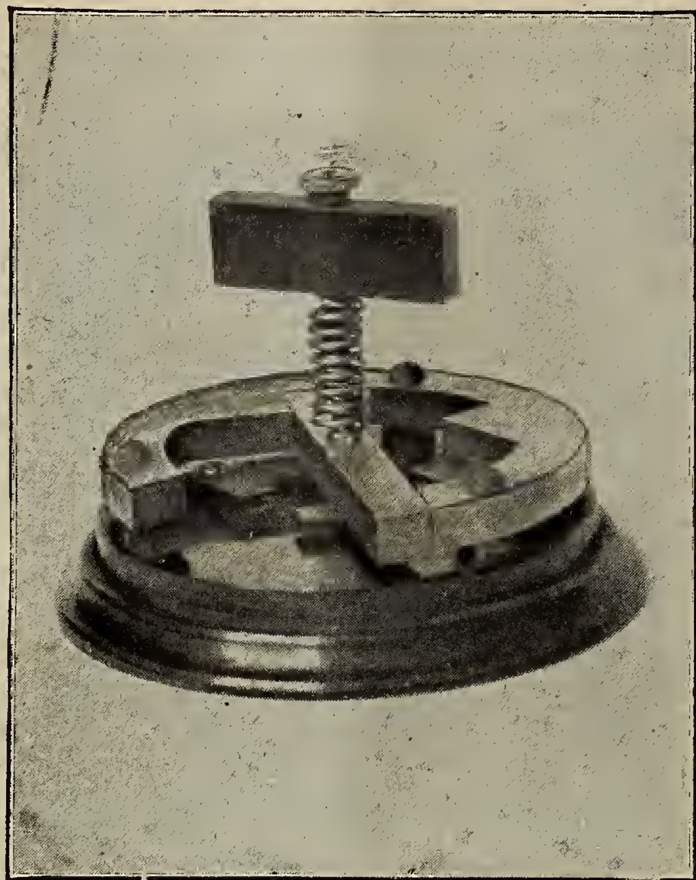
oping, which are still the cause of much more if not immediately attended to—

Poor connections.
Bad joints.

Poor Connections.—The origin of this fault is either hurry or carelessness.

(1) The kind of wiring (either 2 or 3 wire).
(2) The percentage of drop.
(3) The centre of distribution.

The nature of the wiring will depend to a great extent upon the kind of current entering the building—whether it is continuous or alternating. Usually buildings that use alternating current are wired with the ordinary two wire



Switch for Lights.

Fire may frequently be started by either of the above causes; their elimination, therefore, is an enforced necessity.

A wire loosely placed under a screw will generate heat and possibly set fire to something in the neighborhood. In addition the looseness of contact will mean resistance in circuit with the line and cause a decided drop. The evil results in this case are practically similar to those developed in the second case, due to bad joints. They are risks from fire or loss of pressure.

How a Building Is Wired.—When a structure of any description is placed in a contractor's hands to wire, it is necessary for him to decide upon several things.

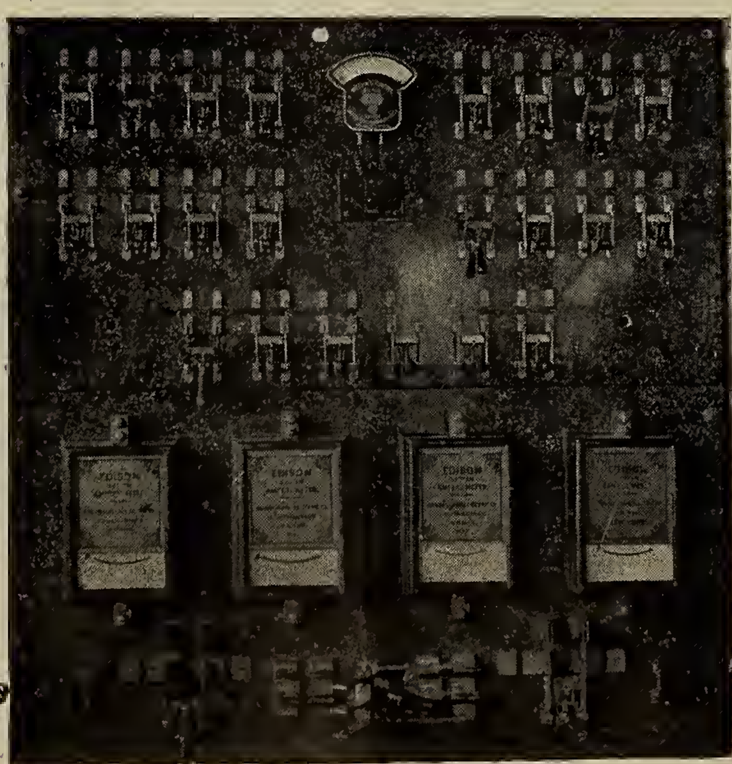
These may be brought to the reader's notice as follows:

system. *The two factors affecting the size of wire or amount of copper used are the percentage of drop and the centre of distribution.*

To wire a building successfully the pressure must be retained throughout as high as possible. A network of wires must therefore be used that will effect this result as nearly as possible. This is where it becomes necessary in attaining this object to select a proper centre of distribution.

A centre of distribution in a wiring system is a point from which all wires supplying the electric light direct are connected. The wires used in any building, according to their function, may be classified under the heading of

Mains.



Switchboard.

Feeders.
Branches.

A building of given size would have a pair of *main* wires run up half way, and then from this point feeders would run above and below, acting as subsidiary mains, and supplying the branches connecting to the lights on the upper and lower floors. This centre, from which all lines stream, is called in compliance with its intended object—*the centre of distribution.*

The wiring of a house as regards its mains, feeders or branches, may all be proportioned by a simple rule whose excellence has been tested in numerous cases. The pliancy of this rule is due to the fact that it takes into consideration the distance in feet, amperes and circular mils,

$$\frac{2 \times \text{distance in feet} \times \text{amperes} \times 12}{\text{volts drop.}} = \text{C. M.}$$

where C. M. = circular mils.

The application of this rule may be illustrated by the following example:

Length of line = 1,000 feet,
Amperes = 50 "
Volts drop = 10 "

$$\text{Size of wire in C. M.} = \frac{2 \times 1{,}000 \times 50 \times 12}{10}$$

$$= 120{,}000$$

$$= \text{No. 00 B. \& S. gauge.}$$

The size of any copper conductor may be found provided the volts lost, the number of lamps and the length of the run in feet is known; an excellent rule for arriving at the size of wire is to *remember* that a No. 10 wire B. & S. has about 10,400 C. M. cross section, and each wire three sizes above or below doubles or halves in cross section. For instance, a

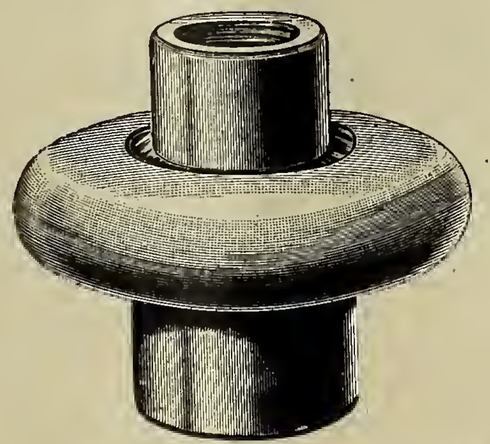
No. 13 B. & S. approx. 5,200 C. M.
10 " " 10,400 "
7 " " 20,800, etc.

This will enable a rapid mental calculation to be made of the size of wire from the circular mils obtained.

Twice No. 10 is No. 7, and four times No. 10 is No. 4, etc. In the last case the C. M. arrived at were 120,000. A size of wire about 12 times as large as a No. 10 would have 120,000 C. M. We therefore consider

$2 \times$ No. 10 = No. 7
$4 \times$ 10 = 4
$8 \times$ 10 = 1
$12 \times$ 10 = 00

The main fact to consider is, that when a wire doubels in circular mils it decreases three *numbers* in size.



Insulation Between Chandelier and Gas Pipe.

A No. 10 wire is 10,400 C. M.; a wire twice its circular mils would be 20,800 C. M., but pass in number from No. 10 three sizes, or become No. 7.

The intervening gaps may be filled in in thirds in the following table:

Approx.	166,400	No. 000 =	167,805	C. M.
"	83,200	1 =	83,694	"
"	41,600	4 =	41,743	"
"	20,800	7 =	20,817	"
"	10,400	10 =	10,382	"
"	5,200	13 =	5,178	"

The column obtained on the basis considered and the real value of the circular mils shows that the nearest size to this approximation will be satisfactory.

The development of a wiring system may be easily considered after the sizes of wire have been obtained.

Drop in Mains.—The drop in mains usually allowed is about five per cent., and in feeders and branches two per cent. The loss in the subways leading from the station to the door may be as much as ten per cent., and provided the pressure is kept constant no evil results follow. Variations in pressure in the subway, however well the place may be wired, will cause ruin and damage to the lamps. Either their pressure will fall very low or become too high and decrease their life.

Testing.—A ground or a short circuit are two common faults in newly wired buildings. The insulation test will bring to light the true condition of the building. Wires imbedded in moist plaster will show a very low insulation resistance. The usual value of this is reckoned by the underwriters as exceeding three megohms (3,000,000 ohms). A Wheatstone bridge is employed for the purpose of localizing trouble. A short circuit will not only blow fuses continually, but show an exceedingly low resistance with the bridge. It may be in a chandelier, caused by crossed wires, or it might be due to defective cut-outs, etc. The blown fuse usually indicates the position of the fault. Grounds are shown by the great and in some cases abnormal decrease in the insulation of the wire. A wire of the bridge connected to earth and another to a main quickly determines the value of the insulation. When the building is free from grounds, short circuits and poor connections, and shows a proper and reasonable perfection, current may be applied to its lamp circuits without further delay.

Suffield, Conn.—W. W. Cooper may give information concerning erection of electric light plant by Electric Light Company.

Hartford, Conn.—Judge F. B. Hall has granted the petition of the trolley company to build connecting trolley lines between Hartford and New Britain.

Portland, Me.—The Portland and Cape Elizabeth Electric Railroad Co. will extend their tracks from Willard to Delano Park.

The Eureka Tempered Copper Works, of North East, Pa., and New York City, has succeeded the late firm of T. J. Murphy & Co., and will continue the business with the aid of T. J. Murphy, J. F. McGuire and N. Murray. Mr. Harry M. Shaw, N. Y., manager of the Eureka Tempered Copper Works, has been appointed general manager of the business in addition to his downtown interests. The company has made a very happy selection in securing the services of Mr. Shaw, as he is very well thought of among the trade as a bright and energetic young business man with unlimited "hustle" and "push." Mr. T. J. Murphy is well known as a pioneer in switch board making, and his knowledge of switch and panel boards is very much sought after by engineers and architects. The high grade of work turned out in the past by T. J. Murphy & Co. will be maintained and they are in a position to complete contracts promptly at prices consistent with first-class work. The works are situated at Nos. 511-513 W. 13th street, and are at present being run to their fullest extent in order to fill the unusually large amount of orders which have been received.

MR. E. LAVENS, General Manager of the General Incandescent Arc Light Co., First avenue and Thirty-second street, New York, sailed on the Germanic April 14 for Europe. Mr. Lavens takes this trip in the interests of his company, and while in Europe he proposes to look over the electrical field with the greatest care and attention. Mr. Lavens is a very popular man in the trade, and is held in high esteem by his company. We wish him every success and a happy voyage.

JOHNSON BROTHERS, 3 Broome street, New York, and 45 Classon avenue, Brooklyn, have their new form sheet out of standard electrical mouldings. Copies sent on application to contractors and supply dealers, with price lists.

MR. R. B. COREY has recently taken charge of the sale of the Columbia Incandescent Lamp in the Eastern territory, in addition to other electrical lines. He will be pleased to have friends call upon him at his office in the Havemeyer Building. We cannot speak too highly of Mr. Corey; he is deserving of a large share of trade in lamps, and we recommend him for his sterling qualities and high character.

Mr. Oscar Hoppe, manager of the Columbia Lamp Co. during the past year, is associated with Mr. Corey.

J. D. MILLER & CO. have secured the order for the complete steam plant of the Consolidated Gas Co. of New Jersey, an addition to the plant at Long Branch, N. J., of a 250-H. P. Fitchburg cross compound condensing engine, medium speed, piping, condensers, etc. This is one of the latest types of engines built by the Fitchburg Engine Co. of Massachusetts, which leads in the rather limited procession of high-grade engine builders. The general agents, J. D. Miller & Co., 39 Cortlandt street, have lately installed a number of complete plants of various sizes for electric light and railway work in the neighboring States. They report business improving considerably and will be pleased to submit catalogues and estimates. Their export trade is steadily growing each year.

WARD ELECTRICAL SUPPLY AND CONSTRUCTION CO., 39 Ann street, New York, have had many demands for arc lamp carbons, which have been promptly met. Their low tension arc lamp business is improving, and contracts for the installation of motors, dynamos, etc., are steadily increasing. Messrs. Levy and Green are persistent in their efforts and conscientious to a degree that always insures success.

THE GARVIN MACHINE CO., of Spring and Varick streets, New York, manufacturers of machine tools, have issued a handsomely illustrated and beautifully printed catalogue and price list of their machinery. The Garvin Machine Co. has approached the very zenith of prosperity, due to the extreme care and unfailing attention to details they have ever practiced. The pages of their little handbook are filled with half-tones and explanations that are worthy of the closest attention. We are pleased with this new sign of their unfailing enterprise.

THE PEERLESS RUBBER MANUFACTURING CO., 16 Warren street, New York, manufacturer of superior mechanical rubber goods, have issued its new spring catalogue. The frontispiece is that of the inventor of Peerless Packing, Mr. John H. Deming, General Superintendent. The catalogue is profusely illustrated, showing every imaginable style of packing, hose, belting, etc., with the prices and details regarding each specialty. This energetic concern has led the way for years, its position being entirely due to its own efforts to support a good article and get a fair price for it.

The following gentlemen were elected members of the New York Electrical Society at the last meeting, held April 7, 1897: H. B. Coho, 203 Broadway; Willard E. Case, Hotel Waldorf; Frank Sutton, Bowling Green Building; Deronda Levy, Ward Electric Construction Co., 29 Ann street; A. Hamerschlag, Cathoscope Electric Co., 26 Liberty street, all of this city.

George H. Guy, Secretary.

The Electrical Age.

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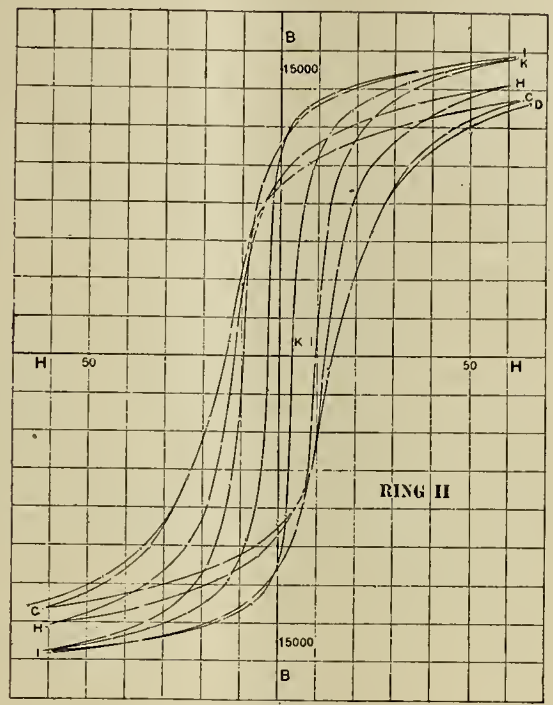


PLATE 2.

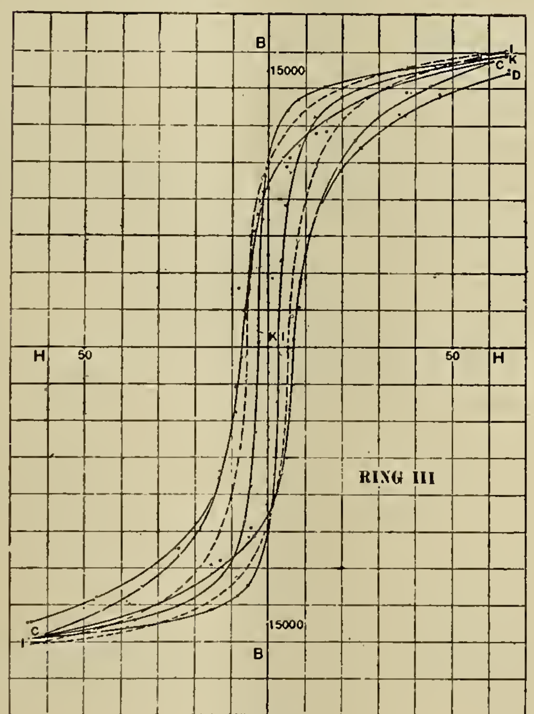


PLATE 3.

THE INFLUENCE OF HEAT TREATMENT UPON THE MAGNETIC PROPERTIES OF HARDENED STEEL.

(Continued from Page 249.)

The hysteresis curves for the steel rings are given on Plates 1–3, the maximum induction (B_m) and remanence (B_r) as a function of the magnetizing force on Plate 4, and B_r as a function of B_m on Plate 5.

D. *Rings reheated to* 100° *for one hour.*—The corresponding curves are marked by crosses on the plates and are drawn only for the low carbon rings, the change being very small for the high carbon steel. The influence of this step becomes more apparent the less carbon the steel contains, and *it consists in a lowering of B_m as well as* B_r in rings II. and III., and in a slight raising of the same quantities in ring I. The coercive force in III. has become slightly larger. *The low carbon steel becomes, therefore, magnetically harder when it is reheated to* 100°. This result is consistent with the observations of Barus and others, mentioned above.

E. *and* F. *Rings were heated to* 100° *for* 24 *hours.*—The heat treatment was the same as in the preceding case, except that the time of the heating was increased. I do not give the results, since no decided change takes place. The curves almost coincide with the preceding ones, though there is an unmistakable increase of permeability, especially for small magnetizing fields, this change being largest for the high carbon steel. We have, therefore, a more or less pronounced influence of the time during which the rings were subjected to this temperature, consisting in a slight increase of permeability.

G. *Rings reheated to* 200°.—Apparatus for the heat treatment: On the top of the heating table were placed two strips of asbestos, on this a disk of the same material with a round hole in the middle, then a layer of iron turnings and on this the ring. The whole was surrounded with an asbestos ring, which was filled with iron turnings, so that the ring was entirely imbedded in the same. The temperature was read by means of a thermometer, which was placed so as to touch the ring inside. By the ar-

rangement described, uniform distribution of heat from the centre was procured. As soon as the temperature rose to 200° the ring was withdrawn and allowed to cool in the air.

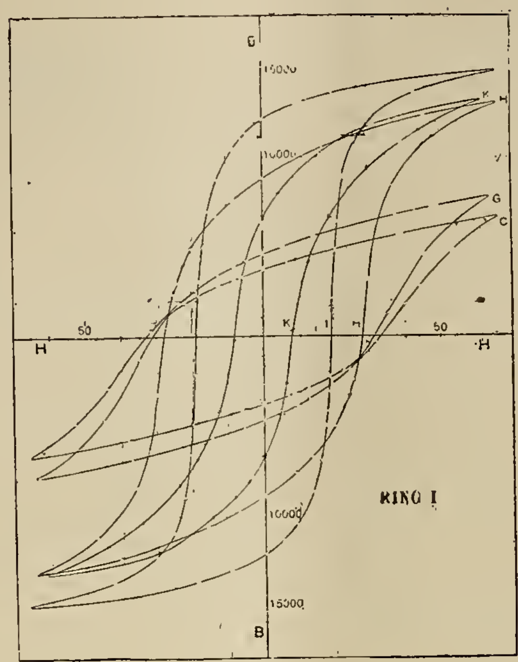


Plate 1.

I give the results for ring I. only, the others showing a very small increase in magnetic induction.

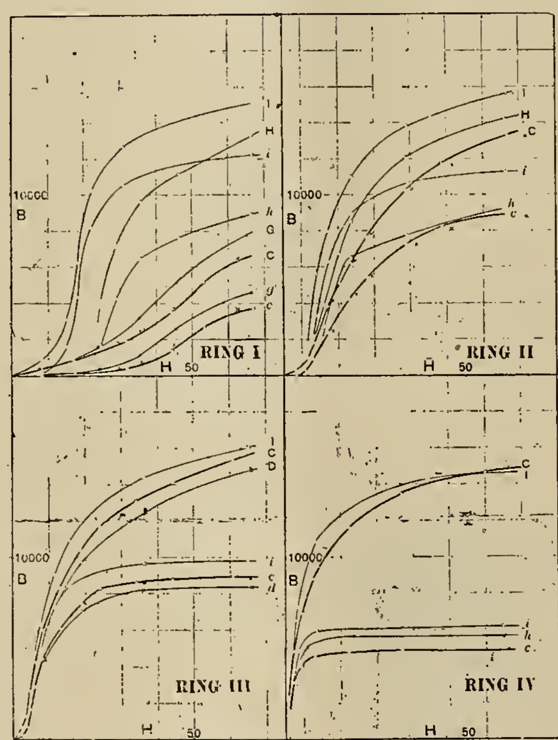


Plate 4.

We will see from the comparison with the data given later on that the increase of induction is comparatively small in all rings.

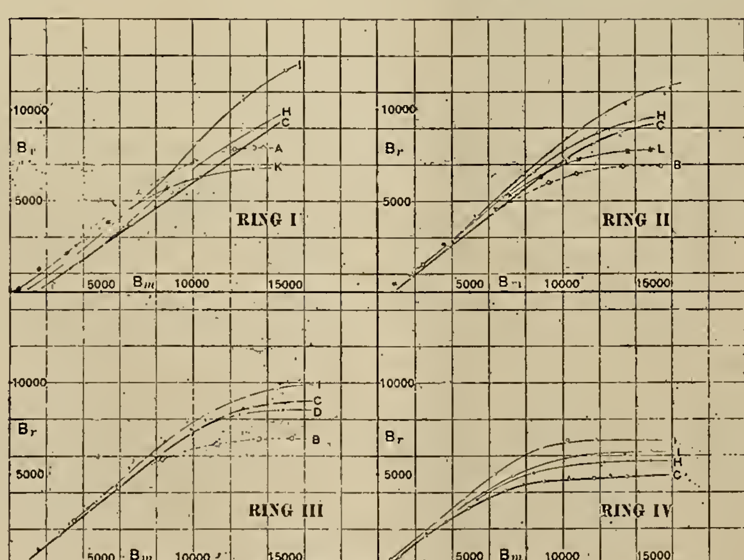


Plate 5.

H. *Rings reheated to* 300°.—The heat treatment was practically the same as in G.

All rings show a decided increase in permeability, the change being the smaller the less carbon the steel contains. The curve for ring III., indeed, coincides so nearly with that of the hardened ring that the points corresponding to this step could be indicated only by dots in the plates. The wrought iron ring, that so far showed no sign of a change, has a larger permeability for small fields than it had before. By comparing the curves on Plate 4, we see a decided tendency towards an increase of the remanence for any given value of maximum induction. This will become more and more decided as we

increase the temperature to which the rings were reheated.

The most important and rather unexpected result of this step is the sudden very large increase in the maximum induction of ring I. The number of lines of magnetic force has almost reached the value the ring had before it was heated at all. Therefore, whatever change in the chemical or physical constitution of the riug produces the change in the magnetic properties, it is largest for the high carbon ring between 200° and 300°, *i. e.*, at a temperature which corresponds to that of the blue temper of steel.

I. *Heated to* 450°.—Heat treatment was practically the same as in G.

We observe a further increase of permeability and induction for all rings. The change for ring I. is only about one-third of the one in the preceding case, while we have a comparatively large change for rings II. and III., corresponding to the large difference in B_m of ring I., observed before, and to be attributed to the same causes.

remanence increased. Another factor in the making of magnets is their permanency. I mentioned the usual method of making permanent magnets in the introduction, and think that a similar treatment, by extending the range of temperature to 450°, will ensure permanency and produce stronger magnets.

K. *Rings annealed.*—The rings were again placed in muffles and heated to a bright red heat, the arrangement being the same as in B and C. After the temperature of about 850° was reached, the fire was banked and the rings allowed to cool inside the muffles. Charcoal was put in the mouth of the muffles. This treatment took about 24 hours.

The rings have become magnetically soft. While in the rings II. and III. the saturation point was practically the same as before, the coercive force decreased to its smallest value, this last step being the largest in the whole series for the coercive force.

In the high carbon steel and the wrought iron we find a remarkable decrease in B_m, accompanied in ring I. by a still greater decrease of B_r, while in the iron B_r in-

Fig. II.

It is to be noticed that, though the magnetic flux has practically reached its maximum for the field strength used, the value of the coercive force is still quite large in comparison with the corresponding value for the rings in the original state. The remanence for ring I. is larger after this step than in any other. The substance is Crescent steel, *i. e.*, magnet steel. It is apparent that, *in order to make strong magnets, it will be advisable to reheat the quenched steel to about* 450°. The magnets could be made more than twice as strong as if simply the hardened steel is used. Though I worked with closed magnetic circuits, the influence of the ends of the magnets will be the same in the two cases. It is of importance that the coercive force did not decrease nearly as fast as the

creases with respect to B_m. These changes can very plainly be observed on Plate 5, where B_r is plotted as a function of B_m. The curve obtained for ring I. differs entirely from any of the curves taken after the ring was hardened, but it shows a great similarity to curve A taken in the original state.

Hoping to obtain similar curves for the other two steel rings they were again annealed, the temperature this time being raised to nearly 1000°. Cooling took place in the same way as before.

L. *Reannealed.*

Both rings show the decided decrease of B_r and the different character of the curve. The one for ring III. is indicated by dots only, and coincides partly with curve C.

In both cases there is a great similarity with the curves B, obtained by heating the originally annealed steel to a high temperature below the point of recalescence and suddenly quenching. It almost seems that the steel by this process has become a different substance. These curves show more the characteristics of the iron (see ring IV. on Plate 5) than of steel. Houston and Kennelly's law does not hold for nearly as wide a range as before. I believe that the effect observed in the last step is not an immediate effect of annealing, but that it is the conditions under which cooling takes place that influence largely the retentivity of steel.

(To be Continued.)

TRACK AND TRACK JOINTS: CONSTRUCTION, MAINTENANCE AND BONDING.

M. K. BOWEN.

(Concluded.)

Upon organization depends the successful maintenance of the track, and one which I find gives the greatest efficiency is that the system is divided up into sections consisting of twelve miles of double track each. Each section is put in charge of a working foreman who is to keep and maintain and repair as cheap as possible, and who is held directly responsible for the condition of the track at all times. He has under him as many laborers as are required to keep his division in repair. This foreman is held completely responsible for all tools and is required to maintain at some convenient point on his section a small place for keeping his tools. All tools which need repairing are sent to the main store room, where they are exchanged for others in good condition. All new tools and material required are obtained from the main store room. The method employed previous to the above was to send out a gang of men here and there at different points of the system; thus one portion of the system might be sadly in need of repairs long before the gang sent out reached that portion.

The question as to the right time to reconstruct a track is one of the greatest importance, as it often involves the expenditure of thousands of dollars. The question to be solved is—am I losing money by not rebuilding my tracks? Should I have rebuilt them two or three years ago, or should I have waited a year or two longer? No doubt many of you have been confronted with just such a question as this and worried over it for days and nights, knowing that the decision meant the expenditure of many dollars for better or worse.

The task of solving this question was brought before me not long ago concerning the State Street cable track, which had reached a deplorable condition. Taking the track master with me we rode over the line and, as street railroad men often do, guessed that it was time to rebuild the track. This involved a very large expenditure, and it would be an expensive guess unless correct; so to ease my conscience and make sure of my guess I had run over the line a car weighing 8,655 pounds, attached behind a grip car by means of a recording spring balance called a dynamometer. This test car was then run over a track newly made at the same speed as over the old line; the dynamometer showed that it took 13.75 lbs. more pull per ton to haul cars over the old line than over the new. The average speed of cars on this street is twelve miles per hour. The excess horse-power required to haul one ton was .44, and the excess cost of hauling one ton one hour was $.0088. The number of tons hauled one mile per year on this track was 45,147,537, and the time required to haul one ton one mile was five minutes; and 45,147,537 tons hauled at a given speed for five minutes is equal in work done to 3,762,295 tons hauled at the same speed for one hour. 3,762,295 multiplied by $.0083 equals $33,108, which is the excess cost per year for hauling cars on account of bad track. It is estimated that the new track with cast joints will last twelve years, and as there will be no low joints the draw-bar pull will not increase much until the rail is worn down sufficiently to allow the wheel to run on the flange; so the annual saving will be nearly $33,108, during the life of the rail, and the

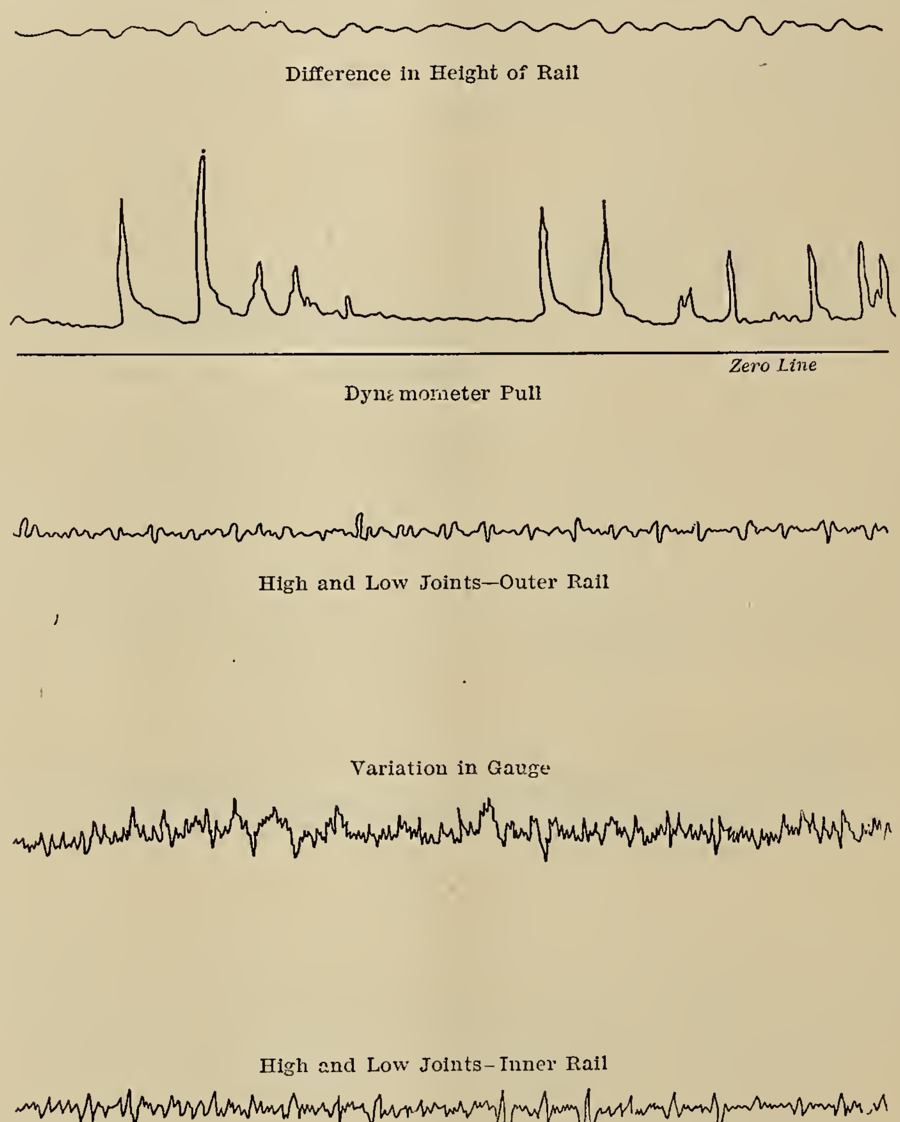


Fig. 12.

total saving will be $397,276, which in twelve years will pay principal and interest on $293,444, which is the amount we could profitably expend in repairs. The actual cost of rebuilding this track was $61,670.

This caused me to think up some scheme by means of which dynamometer or power ratings could be taken and automatically traced on paper, showing the condition of the track at all points, showing faults of gauge, level, or joints; showing faults and excess power in consequence of faults, side by side, thus placing a value on faults; and then, instead of representing faults and excess power in inches or foot pounds, make the instrument show them in dollars and cents per ton of load when capitalized, which would show, multiplied by the ton miles on any road tested the amount that could, with good management, be expended on track reconstruction or rebuilding. The apparatus devised for this purpose is what we call an indicator car. A description of the costruction and method of working might be of interest to not a few, for I do not know of another in use by a street railway company, and found only one other, although very dissimilar, in existence on a steam road, after I had the plans of mine finished.

The results shown by it are high and low rails, low joints, gauge, drawbar pull and the variation of the track level. Each one of these results is automatically platted on paper eighteen inches wide. The car consists of a platform eight feet by ten feet, mounted on a single truck, no springs being used. Midway between the two end axles is one which is fitted with wheels which record defects of joints or gauge. After use and calibration of instrument it will be more valuable and the dynamometer will not be required, as any man using this car constantly will become so accustomed to the value of defects that a glance at the profile will tell him the money he may, with judgment, spend for rebuilding a track or repairing it.

The dynamometer consists of two draw bars, one at each end of the car, and extending beneath the platform to within a distance of about one foot of each other. Between the two adjacent ends of the draw bars a spring is placed, and the amount of pull required to draw the car along the track in either direction is recorded by a recording arm, which is connected to the spring with a wire. The apparatus for showing the variation in the level of the tracks is mounted on the platform and consists of two cups of mercury (having a connection between them by means of a pipe), and into which dip two plungers connected to a recording arm. The paper on which the record is taken unwinds at a uniform speed of one inch per 1,000 inches of track. The car weighs 3,865 pounds. The car is fastened to an ordinary car, which is drawn over the tracks by horses (or any motor car) made to go at as even a speed as possible. The results shown by a recent test trip are very interesting to compare.

Fig. 11 is from an old track—the joints are uncast, spread far apart, and the rails are low at each joint; this is distinctly brought out by the record. The gauge is also uneven. It would appear from the record that the rails spread at each joint. The dynamometer pull is very unsteady, showing the effect of low joints and uneven gauge.

Fig. 12 is a record from a new track; here we can observe hardly any joints or variation in guage, and the dynamometer pull is more steady. Occasionally high points are observed, but they are due more to unsteadiness of speed. A person riding on this track will not be able to detect any joints. This track has the cast welded joint. We find from the data obtained by use of this car that we could afford to expend $7,383 per mile to repair the old track. The estimated cost of repairing this track, levelling and casting new joints, is $1,740 per mile.

The track maintenance during the year 1895 for 184 miles of track cost $158,217, and represented 17.75 per cent. of the total operating expenses. This excessive cost is largely due to a partial or complete rebuilding of many miles of track.

In conclusion I wish to acknowledge receipt of facts and data bearing upon the subject of this paper from Mr. Moxham, Mr. Augustine W. Wright and Mr. Mead; also to thank Mr. W. G. Price for valuable aid rendered me in designing and perfecting the details of indicator car, which can be inspected in the exhibition room during this Convention.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—SKIN EFFECT.

Sufferin, April 14, 1897.

Dear Sirs: Occasionally I hear the expression "Skin Effect" used. Can you enlighten me sufficiently to give me a practical idea of its real meaning? Does it refer to the epidermis, or has it no relation at all to the human body?

Yours truly,
A. C. Canner.

(A.) By "skin effect" is meant the flow of an alternating current on the outside of a wire. A continuous current utilizes the entire cross-section of the same, but an oscillating current leaves the centre and approaches nearer to the outside the higher its frequency. For a very high frequency a mere shell is only required.

(Q.)—LOCATION OF A DEAD GROUND.

Jersey City, April 8, 1897.

Electrical Age.

Dear Sirs: If an electric light line is grounded at several points, one point being a dead ground the other a partial ground, how can they be lifted off the line? I suppose a Wheatstone bridge would be required for this purpose.

Yours truly,
Edwin Hass.

(A.)—The test will at once indicate a dead ground. If a "light" line, a lamp with one terminal connected to a gas pipe and the other to the unaffected leg will prove its existence. The removal of the dead ground will leave the partial ground to be found. A bridge will be required for this purpose.

(Q.)—WELDING WITH A DYNAMO CURRENT.

Philadelphia, April 18, 1897.

Electrical Age.

Dear Sirs: Understanding that two pieces of metal could be welded together by electricity, I attempted the experiment with a heavy dynamo current. The result was not satisfactory, and the metal burned, making the joint uncertain. Can you suggest a means of remedying this difficulty so that a perfect joint can be obtained?

Yours respectfully,
Chas. Freund.

(A.)—It has been experimentally proven that the best current for welding is the alternating. With a continuous current one pole becomes hotter than the other and the weld is therefore not of the best. But an alternating current heats each piece of metal equally; the weld is therefore a success. The Thomson-Houston welding apparatus employs an alternating current.

(Q.)—AMALGAMATED ZINCS.

New York, April 12, 1897.

Ed. Inquiry Column.

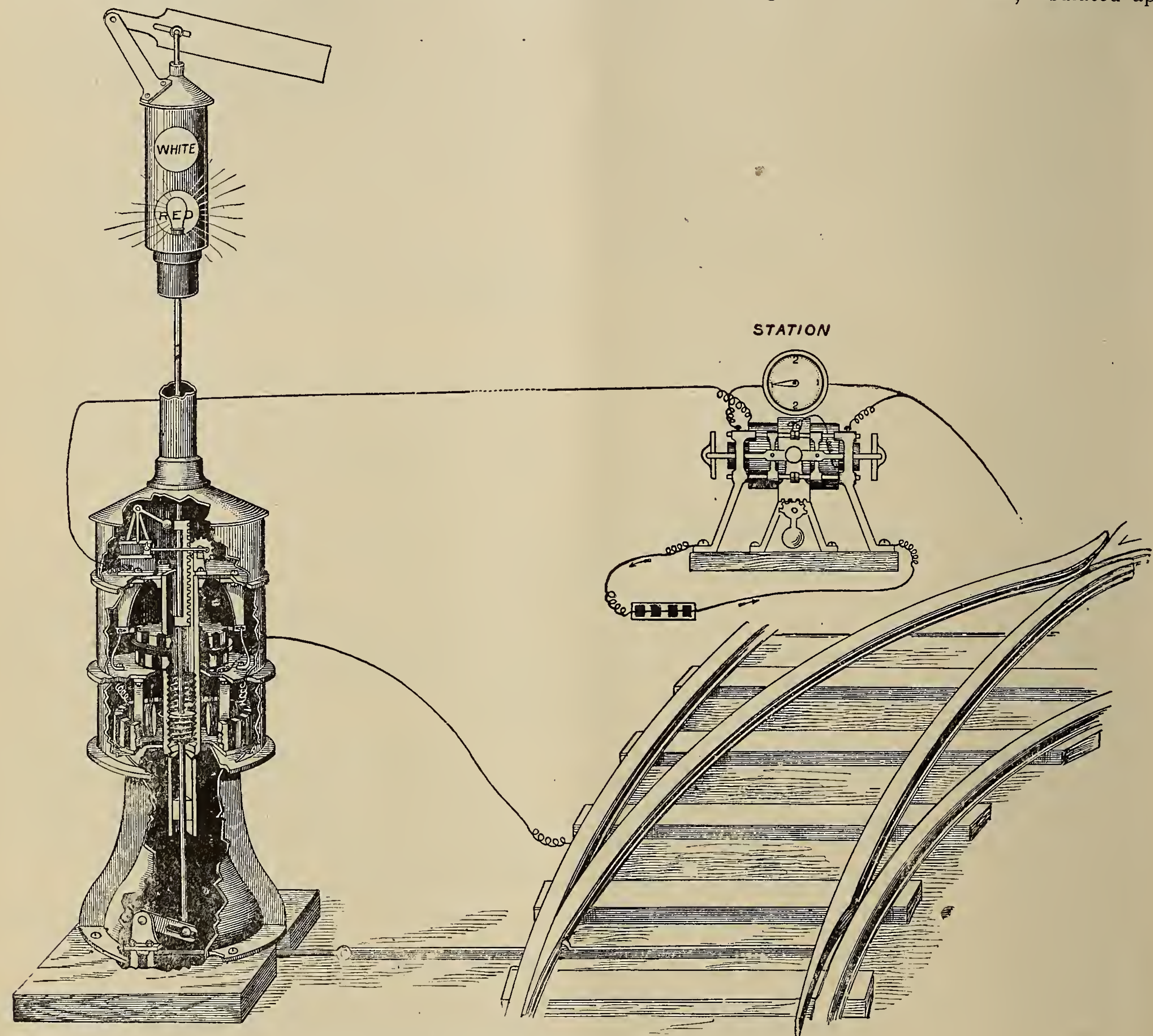
Dear Sir: The difficulty I have of keeping my zincs amalgamated in a battery I use is something great. Why can't a solution be used which contains mercury or, at

least, zinc which has mercury cast with it? I was thinking of building a rubber trough around, a sort of ridge to hold mercury, depending upon capillary attraction for continued automatic amalgamation. Do you think it will do?

Yours truly,

R. M. Pierce.

(A.) Cone-shaped zincs in a porous pot with a spoonful of mercury will be automatically amalgamated. A solution of bisulphate of mercury will keep zincs amalgamated. Zinc cast with mercury is no good. The last suggestion is worth trying.



Mechanism of Electric Self-Locking Switch and Signal Apparatus.

ELECTRIC SELF-LOCKING SWITCH AND SIGNAL APPARATUS.

The above cut illustrates an electric apparatus for operating railroad switches and signals from a point distant from the location of same.

Its chief value lies in its positive action and the facility with which it can be worked in a complete system of switches and signals; also, making block signal systems efficient and economical.

That it is self-locking will be apparent from its construction, thus dispensing with the interlocking devices.

Following the above illustration the appliance at the track may be thus briefly described:

The switch rod is operated by a bell crank, or its mechanical equivalent, the horizontal arm of which engages an upright rod extending to the signal light and semaphore, which it operates; its motion being perpendicular only. This motion is effected by an electric motor fastened to a sleeve, the inside of which is threaded, and revolving about the screw upon the perpendicular rod, thus securing a powerful and simple motion which of itself produces a positive lock.

Above the motor, fastened to the sleeve, is a commutator, consisting of two metallic disks, insulated apart, having radiating and insulated extensions, the outer edges of which are in contact with brushes conveying the current to and from the motor; the upper disk being in continuous contact with a brush communicating with a cut-off, in contact with a line wire; the lower disk having in contact with it a brush in contact with the ground wire.

Stationary on the rod and above the screw is placed a rack operating a gear wheel, the circumference of which is equal to the motion of the perpendicular rod up or down. Its shaft carries a crank which operates a pitman, whose far end moves a sliding head housed in a standard in contact with a line wire. Back of this "sliding head standard" is another standard, which is in connection with the brush in contact with the upper disk of the commutator, and from which suspends a swinging arm weighted at its free end. This arm is in contact with the "sliding head standard," excepting at the last

(Continued on Page 264.)

The Electrical Age.

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CONTENTS.

ELECTRICITY IN WAR.

The present war existing between Turkey and Greece indicates quite clearly that moral perversity is not yet absent from the hearts of our fellow men. Bulwer-Lytton in a romantic, idealistic and semi-scientific tale, called "The Coming Race," points out the impossibility of war existing between nations whose means of assault or defence are so terrible that their mere employment suggests at once the utter extinction of both parties. The famous Kilkenny cats, who fought until there were only two tails left, afford a ludicrous example of this reasoning, as incorporated into the subject matter of a novel by a world-famous writer. It is worth while considering whether modern warfare would cease if its continuation meant to those engaged in it an utter and complete annihilation. The gradual introduction of electrical appliances in the army and navy has been on the increase of late. Range-finders, torpedoes, torpedo boats and submarine vessels, operated by the agency of electricity, and a host of minor inventions have become established parts of a perfect naval equipment. On land the same possibilities exist. A scene that the reader will not forget is described by the great American humorist, Mark Twain, in "A Yankee in King Arthur's Court." The assault of the heavily-armored knights of England upon a "down-east Yankee" whose ingenuity had led him to construct "trochas" of wire through which a death-dealing current passes; all this having been erected in expectation of an attack from the bearded knights of old. It seems that one of the greatest successes the Cubans met with was due to the efforts of an American electrician. He laid a mine of powder or dynamite whose ignition depended upon the pressing of a button far away from the scene of the explosion. It is not unlikely that the advance of an army through a series of wire net-works would be accompanied with a great sacrifice if the death-dealing current passed through it. In fact we may be led to believe that future warfare, particularly the construction of barricades, will be built on some such lines. The relentless and ruthless war carried on between Turkey and Greece would have been impossible had science left a lasting mark upon the accoutrements of both armies. It is frequently the difference and not the equivalence of force that brings on war. Human antagonism is rarely carried to a fatal climax if such extinction is pointed out in the beginning. But between Turkey and Greece, as between the other great nations of this earth, there lingers a strong belief in each other's inferiority; it is this that leads and has led to human slaughter, and it is only the recognition of an individual equality in force of arms and in power of destruction that will make a board of arbitration in spite of its peaceful object other than a farce, such as this war clearly indicates it at present to be.

How Seamless Tubes are Drawn.—Solid drawn steel tubes have been made for years for boilers and general use, but the great demand arose when the safety type of bicycle came into vogue, the diamond frame requiring the use of a greater length of tubing and necessitating that this should be as light as possible. There are variations in the methods for producing a cold-drawn steel tube, but the principle of all is practically the same. Only a very high class of steel is suitable for the purpose, and that hitherto employed has been chiefly Swedish charcoal steel, containing a certain proportion of carbon. The steel is taken in the form of a billet two feet long and about six inches in diameter. A hole is bored through the centre and it is heated, annealed and rolled into the form of a tube about 1¾ inches in diameter, with wall of about 10 gauge. This is then drawn through a die and over a mandrel by means of a draw-bench until about 800 feet long, beautifully smooth and bright both within and without. This is not drawn at once, but in a number of operations, and between each of them the metal has to be repickled and reannealed to prevent the crystallization to which the drawing process tends to give rise. The first drawings of the tube leave it about three eighths of an inch thick, but this gıaduały decreases until a tube is produced which is of the thickness of stout writing paper. This is the class of tube employed in bicycles and that imparts a strength and rigidity out of all proportion to its lightness.—Boston Journal of Commerce.

Fire from Incandescent Lamps.—"There is a most erroneous impression abroad regarding the incandescent light," remarked a prominent electrician yesterday, says the New Orleans Times-Democrat. "Most people have an idea that, encased in glass as it is, it cannot set fire to anything. This idea is not only without foundation in fact, but is very dangerous. An illustration of the truth of what I say is an experience a friend of mine had the other night. He was reading by one of these incandescent lights. The glare hurt his eyes and he tied a handkerchief around the light to soften it. Shortly after doing so he had occasion to leave the room. Fortunately he was not absent long, for when he returned the handkerchief which had been tied around the light had been set a-fire, and, dropping on the table under the light, had ignited a lot of papers. The papers, table and all, were blazing away merrily when he returned."

St. Louis, Mo.—The Cupples Electric Light, Heat and Power Co. has been granted permission to complete its underground system.

Forty Fort, Pa.—C. G. Mumford, Secretary, may be addressed concerning establishment of an electric light plant.

Eutaw, Ala.—An electric light plant will be established.

moment of the gear wheel's revolution, when it is tripped by trigger on the sliding head and falls free, thus cutting the current and stopping the motor. The weight of the ball then compels the arm to fall back again into contact, when it is ready for the next operation of the switch.

Repetition of the motion is prevented by an instrument in the office or tower from where the motor is operated. This instrument consists of an electromagnet, excited by the same current and in the same direction as those in the motor at the switch. At each end of this magnet is an armature, either one of which (depending upon the direction the switch is to be thrown) is held against the core as long as the current is continued, but when interrupted by the cut-off (at the track) described above, the armature falls back, impelled by a weighted segment, the movement of which throws the instrument out of contact, in which position it remains until the current is again turned on by the operator. This falling back of the armature is a guarantee that the operation at the switch has been completed.

This motion also records the position of the switch at the track, by simply recording on a dial, in figures, the last direction of the current. For switching purposes the motor, commutator and automatic cut-off may be laid horizontally between the tracks, the screw-rod directly operating the switch-rod. For information and particulars address Chas. G. Smith, 123 Water Street, Pittsbnrgh, Pa.

MEASUREMENT OF CANDLE-POWER.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

In measurements of candle-power a great difficulty has been met with which, although partially overcome, still leaves the final settlement of it in doubt; that is, the use of a standard of light. A gas jet gives sixteen candle-power, an incandescent lamp sixteen, and possibly some oil lamps; but should either be adopted as a standard it is very difficult to keep track of the deterioration in light and feel secure, in using it, that no great error is made. In other words, we have no absolute standard of light, and therefore our methods, though perfect, have not a very accurate foundation. The use of a fixed standard is necessary. In order that a test can be made which will amount to more than an experienced guess, a good reliable standard which will not change very quickly is most desirable. The standards at present in use vary somewhat in their nature. The English candle has been looked upon as best for a long while, but opinions have been slowly changing. The use of other standards has become general, and the following sources of light for photometric tests tried with a variety of results :

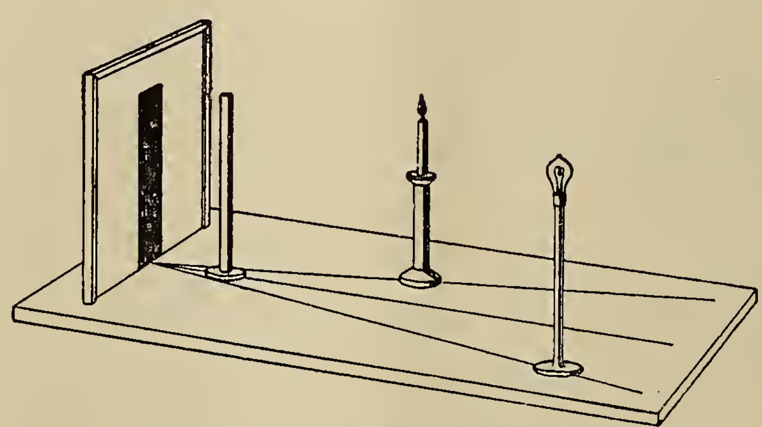
STANDARDS OF LIGHT.

Carcel lamp,
British standard candle,
German standard candle,
Amyl-acetate lamp,
Pentane lamp.

The above are but a few of those that have been tried. One method that appeals to the electrical engineer is the heating of a strip of platinum to a given temperature by a known current, or the light emanating from a crater in an arc lamp. The paper entitled "Standards of Light," read before the American Institute of Electrical Engineers, May 20, 1896, is very complete, and treats this difficult problem in a masterly manner.

The standard that cannot be depended upon is the English candle; in fact, any source of light subject to such fluctuations and burning with such unsteadiness.

The standard must be of definite chemical composition as well as the medium around it. When a light has been produced that shows but slight variations, the problem of measuring light will be resolved down to a firm basis and become in every sense of the word a science.



Rumford's Shadow Photometer.

In lamp factories a filament carefully made is selected and its candle-power, measured with all possible accuracy, used as a standard for the rest. A dark room is very essential for lamp tests. In any factory making illuminants or apparatus for such, a photometer room is used constantly. It is simply a room shut off from all daylight. A scale is within; at one end the standard is placed, at the other the light to be measured. Either one is now kept stationary. The screen between with grease spot is used, as in the simplest photometer, for determining the equivalence of the intensity of light on each side. Rumford's photometer employed a screen and made use of the shadows thrown by the standard and other light as a means of comparison.

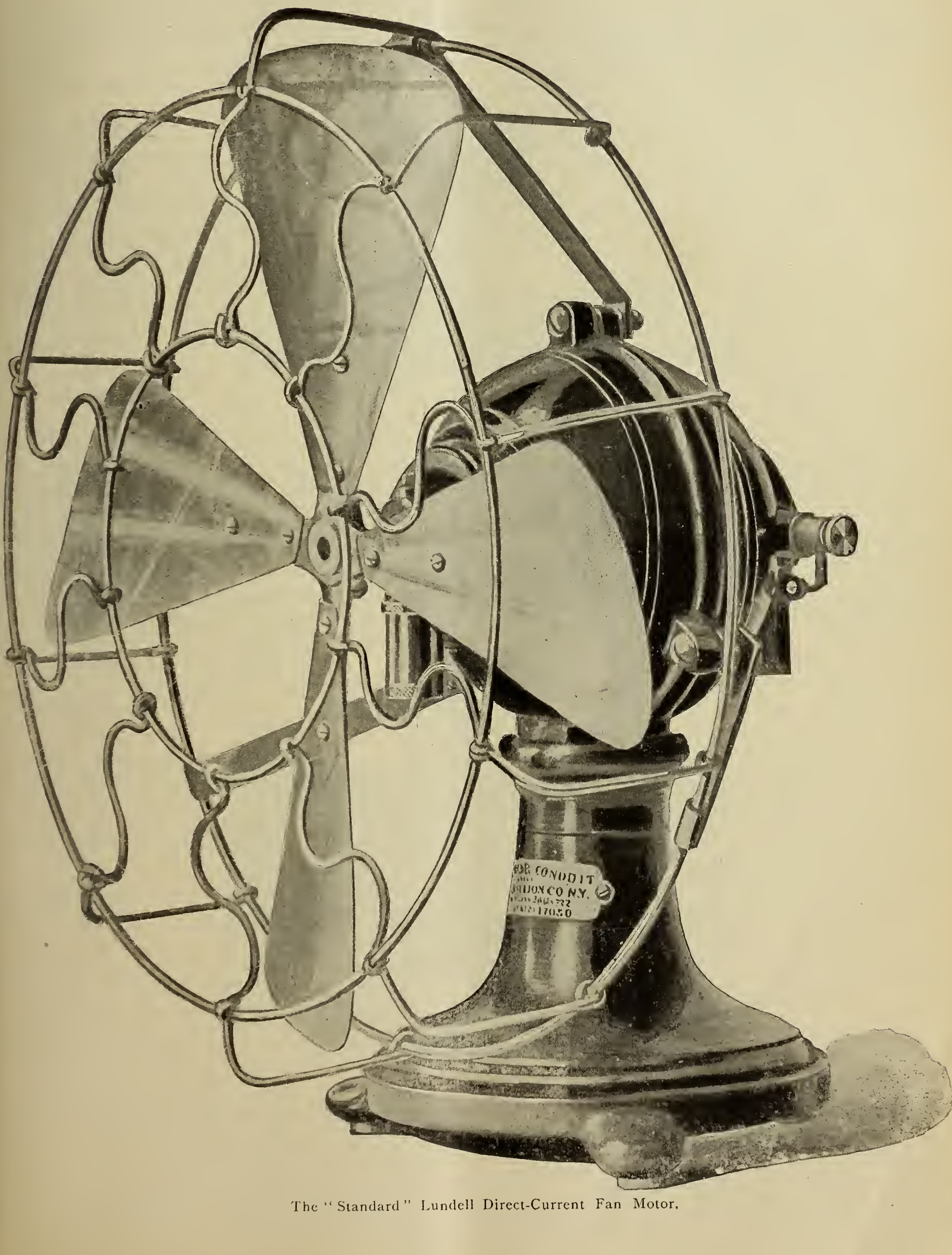
A stick mounted before a screen will throw two shadows, one due to the standard, the other caused by the unknown light; when both shadows are alike, the respective distances are compared. If the standard is one foot away and the other three feet, provided the shadows thrown are equal, the second is nine times as strong as the first, or nine candle-power.

Daylight is the light all scientists and inventors are striving to obtain. Their object is to produce light without heat, and thus illuminate city and home in the most perfect manner.

Burlington, Iowa.—The Burlington Electric Railway has been sold to a Boston syndicate, and about $100,000 will be expended on improvements to same this spring.

New Milford, Conn.—A new trolley line is to be built from here to Lake Wanamaug.

Patchogue, L. I., N. Y.—The Patchogue and Port Jefferson Traction Co. has been granted a franchise to operate a cross-island trolley between this village and Port Jefferson.



The "Standard" Lundell Direct-Current Fan Motor.

THE LARGE GAS ENGINE, ITS PRESENT DEVELOPMENT AND FORECAST OF ITS FUTURE FOR ELECTRICAL PURPOSES.

(A paper read by Mr. E. F. Lloyd, Secretary of the Western Gas Construction Company, Fort Wayne, Ind., before the Thirteenth Annual Meeting of the Ohio Gas Light Association.)

The present development in gas engine design is divided sharply into two general classes, single-acting and double-acting. The former is much older and still much more in use; the latter is a comparatively recent development, and has aimed more to occupy the field of higher powers than has its single-acting competitor.

Of the single-acting engine there have been a number of types, of which it is sufficient to say that the only one which has survived to attain a widespread reputation is the "Otto." I refer in this connection to the "*cycle*" upon which the engine operates, and which is completed in four strokes. or two revolutions.

In double-acting engines the original practicable type was known as the Griffin, or six-stroke cycle, which introduced an idle revolution for the purpose of cleansing the cylinder from the products of combustion which remain in the compression chamber of the Otto cycle. This scavenging revolution, however, was abandoned, and the Otto cycle substituted; but the double action, in general design the same as the ordinary horizontal steam engine, was retained, and this feature constitutes the essential difference between the two types.

It is only within the last three years that the double-acting type has been seen in America, and consequently is familiar to but few. Originating in England, with the engineering firm of Dick, Kerr & Company, it has been in successful use for about 10 years.

The essential differences existing in their operation are directly consequent upon the difference in design, and as the single-acting is much older it will be proper to consider that first. In all well-known single-acting engines, as now built, the piston is its own crosshead; that is, the connecting rod is pivoted directly into it, and there is no piston rod. While this permits a short, compact machine, it necessitates a heavier constructiou of piston, and, what is much more serious, it forces the wear of the "angle thrust" of the connecting rod on to the bottom of the cylinder. This may be made clearer by saying that the pressure of the explosion is applied at the back of the piston, and in the consequent forward movement the front end of the connecting rod rises with the swing of the crankshaft—owing to the wristpin joint being in the piston, it causes, so to speak, a "buckling" tendency which presses downward upon the cylinder bottom. In small engines, when well lubricated, this is not a serious matter, because the heats are not so great as to impair the lubrication, and the weights and pressures do not exceed the cylinder's *wear-resisting* qualities; but in large engines the conditions are different, the power of the impulse and angle thrust, and the necessary weight in the piston and connecting rod, increasing very much more rapidly in proportion than the wearing surface on the bottom of the cylinder, together with which is the increasing difficulty of proper lubrication in the greater volume of heat. All these causes working together seem to fix the practical limit of the single-acting engine at about 16 inches diameter of cylinder, corresponding to about 75 indicated horse-power. Larger engines of this type have been built abroad, but they have not, so far as we know, become a commercial factor.

The regulation of single-acting engines for electrical work presents much difficulty. The maximum of explosions being one in four strokes, on anything less than full load frequently eight or even twelve strokes intervene between explosions. This irregularity has to some extent been overcome by the use of heavy fly-wheels and high speed in the engine, supplemented generally with a countershaft carrying a solid or a spring balance wheel and the belting done from that to the dynamo. In this manner, through the inertia of the wheels and the elasticity of the belts, a fair degree of steadiness has been obtained, but necessarily at an expense of power and floor space. The difficulties in the way of effecting their sensitive regulation are twofold: First, the long interval between impulses; second, the inherent irregularities in mechanical governors themselves, due to inertia, friction, uneven lubrication, wear and actual work frequently to be performed.

In turning to the double-acting engine of ordinary construction we find many of the difficulties to contend with met in the single-acting; except, that they are greatly modified in their effect, the practical result of which is to permit the engine being built to very much greater powers, the exact limit of which we do not know, but can safely state it at not less than 500 I. H. P. in a single cylinder. This increase is simply illustrated by saying that if a 16-inch cylinder will develop about 75 H. P. in a single-acting engine, if the same pressure is applied to the return stroke, making it double-acting, it will give 150 H. P., and this is approximately true. But there are other conditions which greatly increase the power possibilities of this type.

(To be Continued.)

Paris, Ky.—A company will probably be formed to build an electric line.

Port Lavaca, Tex.—An electric light plant will probably be installed in the Bay View Hotel.

Baltimore, Md.—The Falls Road Electric Co. (George R. Webb, Equitable Building, General Manager) will commence work on its trolley road to Mount Washington.

Xenia, O.—J. S. Jones, President Board of Trustees, O. S., and S. O. Home, may be addressed concerning construction and operation of an electric light plant.

Albany, N. Y.—The electric street railway will be extended from Hoosick Falls to Bennington.

Lancaster, Tex.—Address Mayor concerning establishment of electric light plant.

Jackson, Miss.—The Mayor may be addressed for information concerning construction of electric railway in connection with an electric light plant.

Louisville, Ky.—The Louisville City Railway Co. will change its Oak and Brook street divisions to electric systems.

Baltimore, Md.—The Central Passenger Railway Co. (George Blakiston, President) is considering a further extension of its electric line in the northeastern part of the city.

New Haven, Conn.—The North Haven Electric Light Co. has received permission to incorporate, and will commence work on the erection of its electric light plant.

Brookings, S. D.—An electric light plant will be put in at the agricultural college, to light the buildings and furnish electricity for mechanical and scientific purposes.

Webster City, Conn.—The Electric Street Railway Co. contemplates an extension from Grosvenordale to the different villages in Webster.

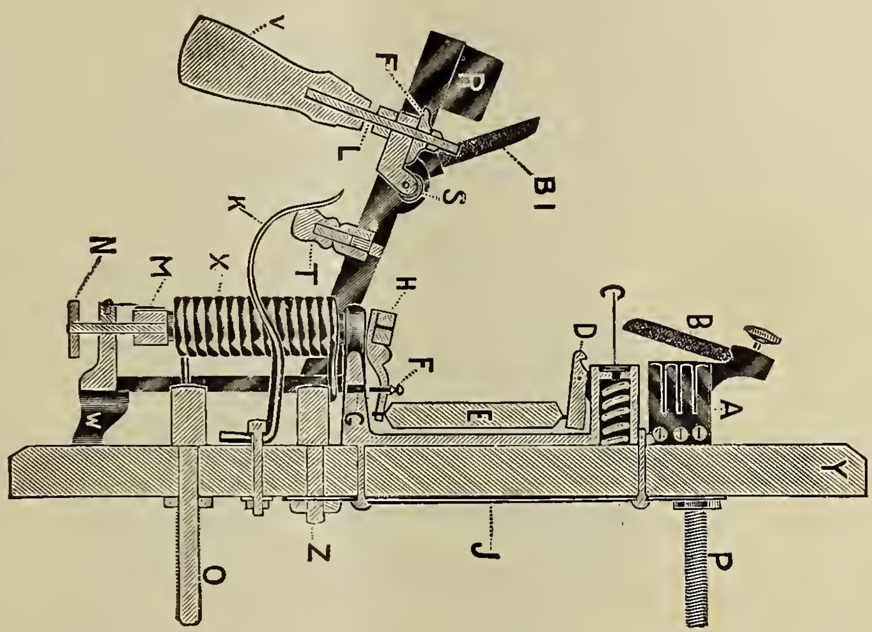
Pontiac, Mich.—The Oakland Electric Railway will probably be extended to Pontiac.

Constantine, Mich.—H. W. Francisco, Village Clerk, may be addressed concerning lighting of streets by electricity.

Edenton, N. C.—City Clerk may be addressed concerning establishment of electric light plant.

ATLANTIC CIRCUIT BREAKERS.

Fuse wire has proved so unreliable to all users and electrical engineers as a safety device for protection from short circuits, overloads, or grounds, and offering no protection from lightning storms whatever, that the electrical public has turned its attention to the use of automatic magnetic circuit breakers as a reliable substitute for fuse wire.

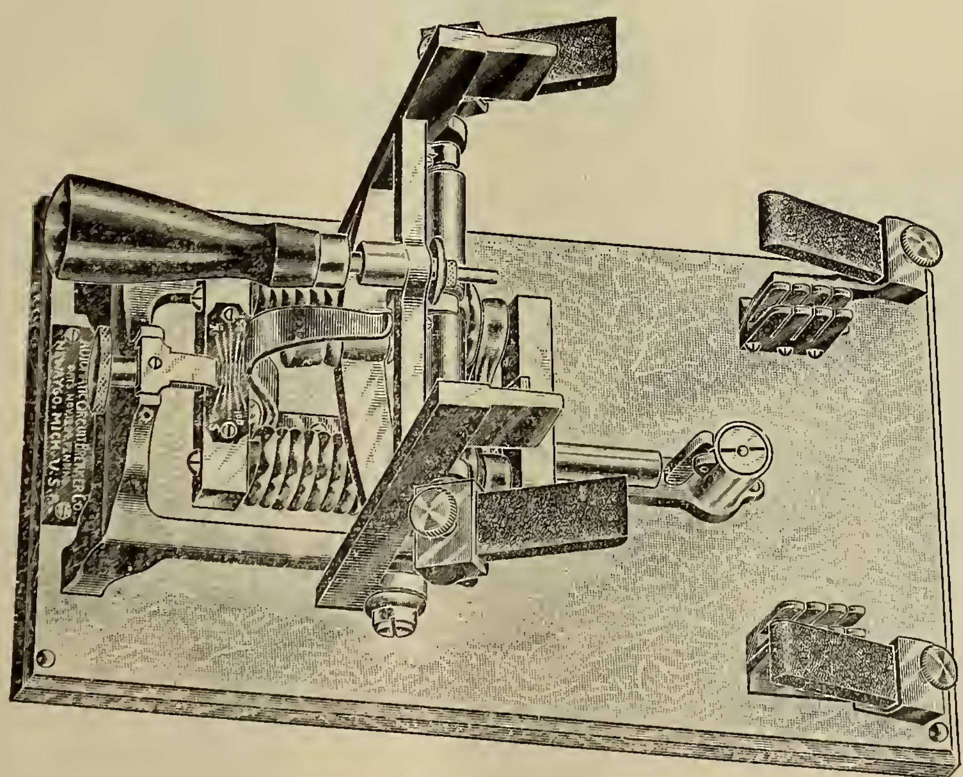


AUTOMATIC CIRCUIT BREAKER CO.
NEWAYGO, MICH.
Section.

We illustrate the well-known automatic circuit breakers or limit switches made by the Automatic Circuit B•eaker Co., Newaygo, Michigan, with their latest improvements. Cut 1 shows circuit breaker closed. Cut 2, circuit breaker open, or as it appears after circuit is broken. Cut 3, sectional view, showing on a line drawn through center of instrument.

Y represents base, either marble, slate or other suitable material, preferably slate. A, copper contact. B and B1, carbons upon which they make their final break. C, dash pot that gives break frame, R, its sudden blow through handle V, which has about one-eighth of an inch play, as shown at L, so that it gives break frame a hammer blow, overcoming any possible chances for contacts R and A sticking. D, latch. E, small weight to return armature to place after instrument has operated. F, screw through armature holder, making contact on point shown at G, which is a piece of iron running to magnet core and is magnetized so that it holds armature up until current exceeds the predetermined point. Then magnet G releases screw F, giving a hammer blow to E against latch D, and releases disk F, which is the catch on frame R, and a part of handle V, all movements being positive knock out blows. M is the graduation plate, graduations on their instruments being in amperes. N, adjusting screw for adjusting capacity, either increasing or decreasing to any predetermined point between the minimum and maximum graduations. They have displaced all springs and intricate parts by a new and novel use of magnetism, being points F and G, which is always positive and never varying in principle or operation.

They make a positive guarantee that their instruments will operate within one per cent. of their set capacity under any and all circumstances. They have them in use on all systems and voltages, and claim to manufacture the only successful alternating current circuit breaker now on the market. They attribute a great share of their success to the fact that they send out one or a full equipment to their customers subject to approval, and if not entirely satisfactory to them in every way, they are under no obligations to them excepting to promptly notify them so that they can send shipping directions for the return of the instruments. This being the season of the year when one should look after the protection of their electrical apparatus from lighting, and with the liberal views that this company have in the sale of their in-



Automatic Circuit Breaker—Open.

struments, one should not hesitate to take up the matter of better protection to their electrical apparatus by the use of automatic circuit breakers.

A NEW LIGHT FROM CALCIUM CARBIDES.

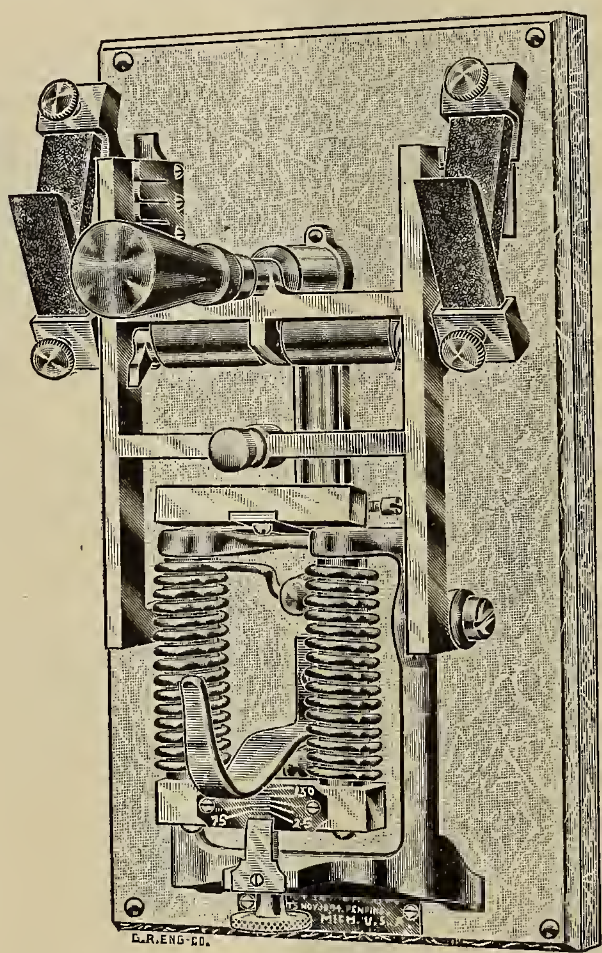
(Concluded).

This constitutes the whole process of manufacturing the new calcium light from the preparation of the lime and coke onward, which, as explained, is extremely simple and inexpensive, requiring no skilled labor and little machinery. The only reason why it is new as a commercial product is the difficulty of causing a combination between the calcium of the lime and the carbon of the coke. Nothing short of the temperature of the electric furnace, 3,500 to 4,000 degrees centigrade, will bring this about, and the comparative modernness of this new apparatus for the calcium light accounts for the lateness of the calcium carbide. This calcium carbide, pure, when produced, has a specific gravity of 2262; in a dry atmosphere it is odorless, but on exposure to moisture it evolves the peculiar odor of acetylene. When exposed in lumps to the action of ordinary air it becomes coated with a layer of hydrate of lime, which protects the interior of the mass from further oxidation. In form the carbon for producing the calcium light is a dark grayish or dense red mass, which, upon fracture, shows a crystalline metallic surface.

This compound of calcium carbides when prepared is placed in one of the copper vessels, which is part of the newly invented apparatus for producing the calcium light, another vessel placed above the one holding the solid substances contains water, and is directly connected with the lower receptacle containing the carbides by means of tubes which feed the waterway automatically when the gas is to be generated. From this the direct flame is obtained, the gas being conveyed to the burner by means of small pipes about the size and neatness of an electric wire.

As regards the amount and quality of the light obtained from carbides properly burned, there seems to be no question as to its great superiority over coal and water gas, and the new calcium light which much surpasses even incandescent gas in its luminosity, produces a beautiful, exceedingly brilliant and highly luminous flame. It also differs very advantageously from similar illuminating gases recently discovered in being non-explosive. The inventor claims that the danger of explosion is completely excluded in his process of producing gas.

The construction of the apparatus is so very simple and small as to render its use possible everywhere, since, too, the use of the many pipes and connections so necessary to distribute incandescent gas in a community is done away with; every household could, by setting up a small apparatus, effect the filling and feeding quite independently, and at a small expense. According to trials and experiments recently made a flame of from 30 to 40 candle-power can be produced at a rate of about ¾ of a cent per hour, and after more experience and improvement in the manufacture of calcium carbides it is claimed that even this low rate will be considerably reduced. The calcium light may be used for heating and technical purposes as well as for illumination without the application of special manipulations. On the whole, then, it may be said that the new calcium light, acetylene, and other gases produced from calcium-carbides promise to be important rivals of the present methods of illumination, and deserve the careful examination of both the consumer and manufacturer of light-givers.



Automatic Circuit Breaker—Closed.

A REMINDER.—After Thursday, April 22, the address of our New York office will be Room 506–8–10, Telephone Building, 18 Cortland street, at which location we will have much more desirable and spacious apartments than at present, and, at that address, we will be pleased to welcome our friends and customers as heretofore.

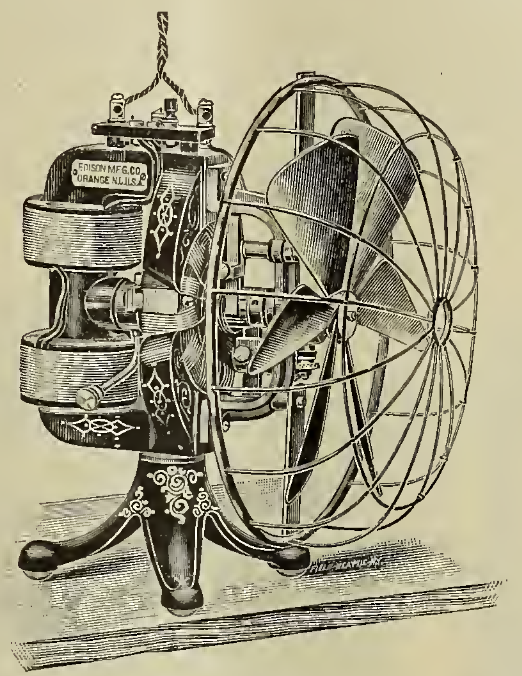
Our wires, cables, conduits and accessories still maintain their position, i. e., the best on the market at reasonable prices, and we earnestly solicit your communications.

Yours very truly, Standard Underground Cable Co.

Campville, Conn.—The Consolidated road, it is stated, will erect an electric power station at Campville on the Naugatuck division, to operate all way passenger trains between Waterbury and Winsted.

THE EDISON MANUFACTURING CO.

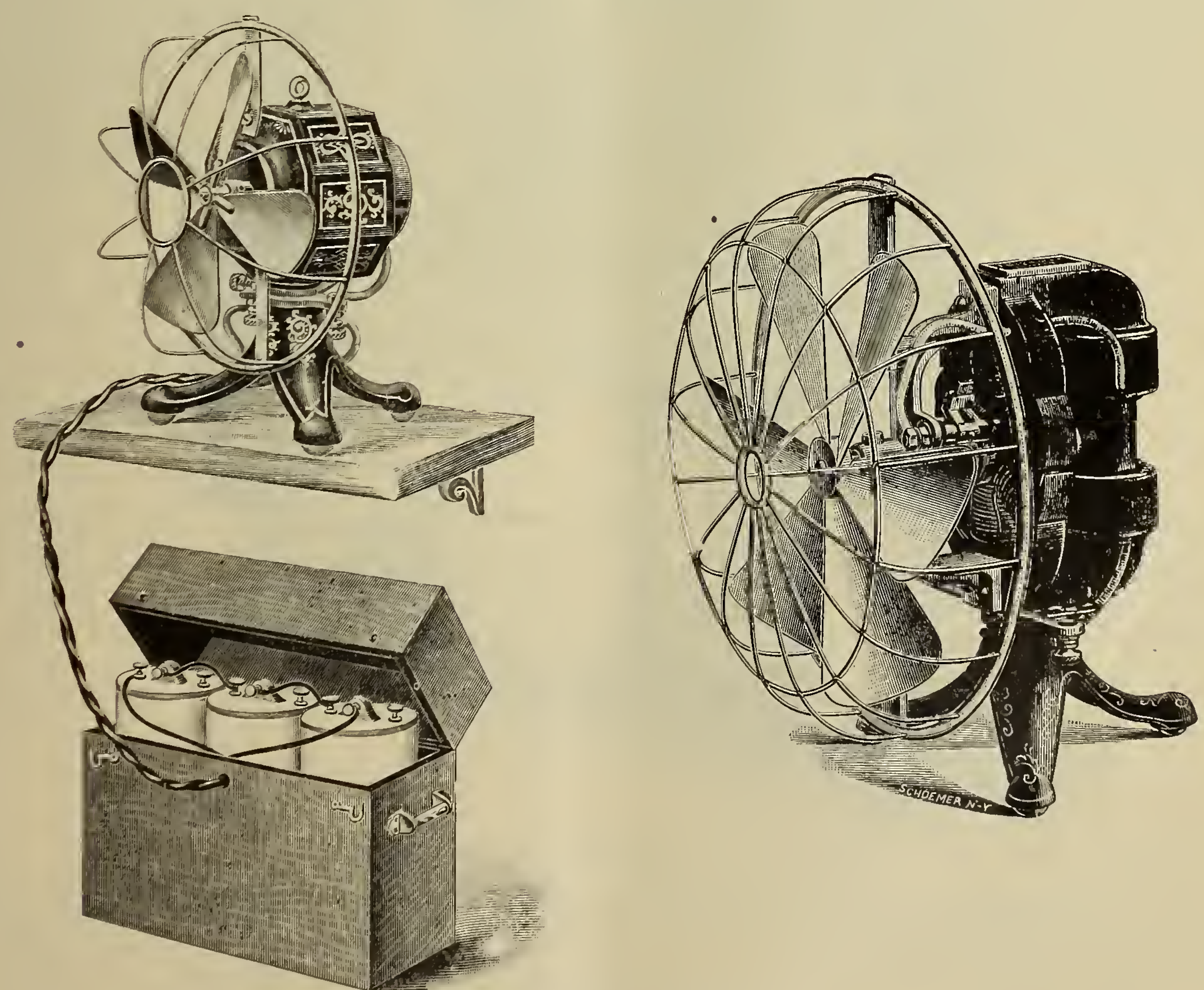
This concern has been engaged in the manufacture of special electrical outfits for many years. It has acquired a noteworthy position in the trade by virtue of its compact, convenient and durable fan motor outfits.



New Edison Fan Motor for 110 Volts.

The nine-inch Edison motor outfit consists of four Edison Lalande cells, type "S" porcelain jars, contained within a portable polished oak box 25 inches long, eight inches wide and fifteen inches high, an Edison battery motor with nine-inch guard and fan and the accessory ends, etc., for connecting up. The smoothness of operation and sparklessness of this fan is indicative of the best workmanship and most efficient construction. The fan is driven at 950 revolutions per minute with a current of 1.9 amperes. A nine-inch motor to run on the 120-volt direct-current, similar in construction to the nine-inch battery motor, is manufactured by the above company. It has three speeds: 1,400, 1,700, 2,100 revolutions per minute, and takes at these speeds .3, .4 and .5 of an ampere, respectively. The self-oiling bearings save all attention and time.

The new Edison fan motor for the 110-volt direct-current, cut of which is herewith shown, is similar in construction to the Edison 9-inch battery fan motor and carries a fan of this size. It is so constructed that it can be connected across the line, and it is provided with a three-speed switch, by which the current can be regulated as follows:



Edison Battery and Fan Motors.

1400 R. P. M. 1700 R. P. M. 2100 R. P. M.

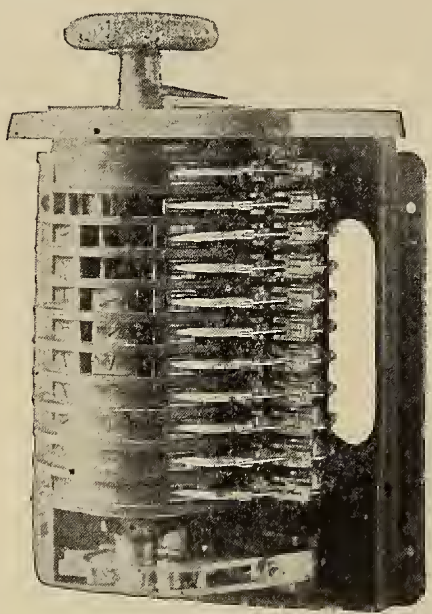
The watts used at these various speeds are 36, 48 and 60 watts respectively. The workmanship of this motor is of the very highest grade and it is handsomely finished.

The Edison Manufacturing Co., 110 East 23d street,

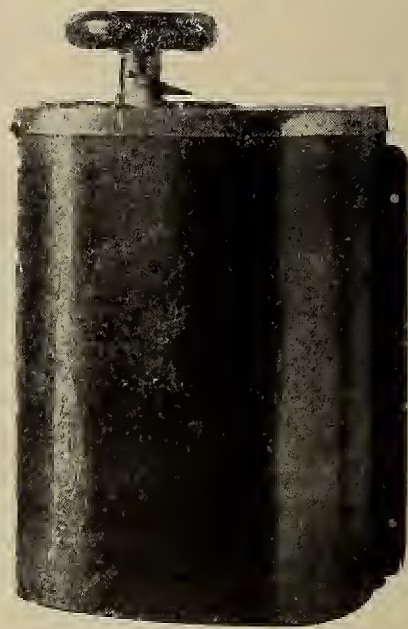
New York, have these outfits on exhibibition at their show rooms. Mr. Gladstone, the manager, will be pleased to show the interesting appaiatus underhis charge to intending purchasers.

LUNDELL CONTROLLER.

The Lundell motor, when applied to a press, lathe or other machine, is supposed to start, stop, etc., in a systematic manner. The operator has then the proper control over the motor and over its speed. A controller



Interior of Controller.

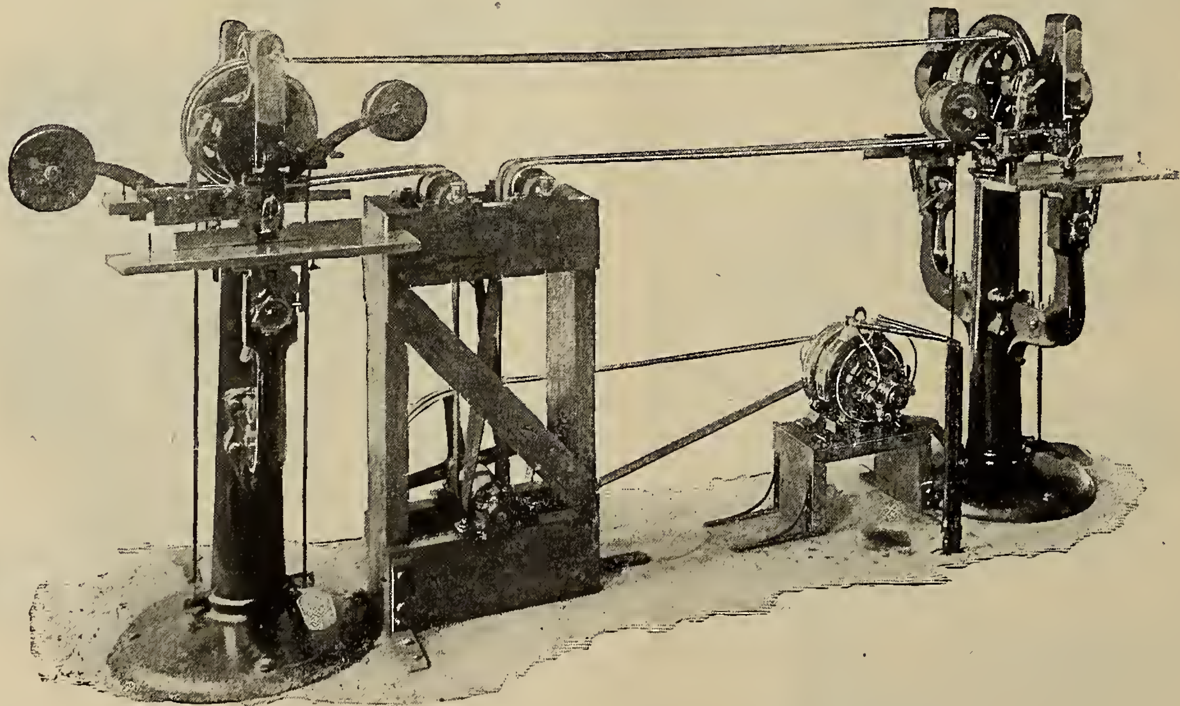


Exterior of Controller.

giving all these facilities is therefore of the greatest imaginable convenience to the attendant. In the illustrations the exterior and interior of the controller is to be seen. The usual method followed is that of starting, stopping or reversing, and the obtainance of five different speeds. No external rheostat or resistance is used.

In the other cut is represented two stitching machines operated by Lundell motors.

Many sizes of presses and binding and stitching machines are required in a modern printing house. The



Stitching Machine Operated by Lundell Motor.

Interior Conduit and Insulation Co., of 527 West Thirty-fourth street, New York, are prepared to give details and prices of installations of this kind complete.

Halifax, N. S.—A bill is now before the provincial legislature to incorporate the Halifax and Bedford Electric Company, for the purpose of operating an electric tramway and supplying power. The capital stock to be $300,000, and amongst the promoters are H. M. Whitney and A. E. Sullis.

HORSELESS CARRIAGES IN ENGLAND.

In a former report, "Horseless Carriages in Europe,"* mention was made of the existence in England of a law known as the "highways and locomotives act," which prohibited any locomotive propelled by steam or other than animal power from being driven at a speed of more than four miles an hour on the common roads and highways. This law embodied several other observances in the use of locomotives, which practically prohibited modern horseless carriages in England, they being deemed to come under the meaning of this act. I expressed my belief that it would not be long before Parliament would amend this law so as to remove the restrictions in so far as horseless carriages were concerned. This has since been accomplished, the limit of speed now fixed by law being 12 miles, instead of four miles, per hour.

Following the example of French owners of horseless carriages, whose road race from Paris to Bordeaux was described in the report above referred to, the English have just had their first successful road trial, which took place on the 16th instant between London and Brighton. The trial, or, more properly speaking, race, aroused the most intense public interest, which was manifested by the enormous crowds at the place of departure and along the route to Brighton. The masses of people around the Hotel Metropole, in London, where the start was made, were so dense that the police could not keep people from blocking the street, and regular order in starting and placing the vehicles was out of the question.

The start took place promptly at half-past 10 A. M.,

* Printed in Consular Reports, No. 190 (July, 1896).

Mr. Hy. Lawson leading the way in his phaeton, followed by one of the Panhard-Levassor carriages, which had been successful in the Paris-Marseilles race; after this came a Daimler phaeton and a private carriage, also of the Daimler type and Mr. Lawson's second carriage, which took part in the lord mayor's procession recently. It was hoped that the police would be able to preserve perfect order, but the immense throng of people rendered this impossible, with the unfortunate result that about half of the carriages were unable to start at all. The progress through the city of London was, owing to the crowding, necessarily slow; and not only did the crowds impede the progress of the carriages, but a raining day, with head winds, added a further impediment to speed.

Leaving London at about half-past 10 o'clock and travelling over 54 miles of the most hilly country in all England, the arrivals at Brighton were in the following order:

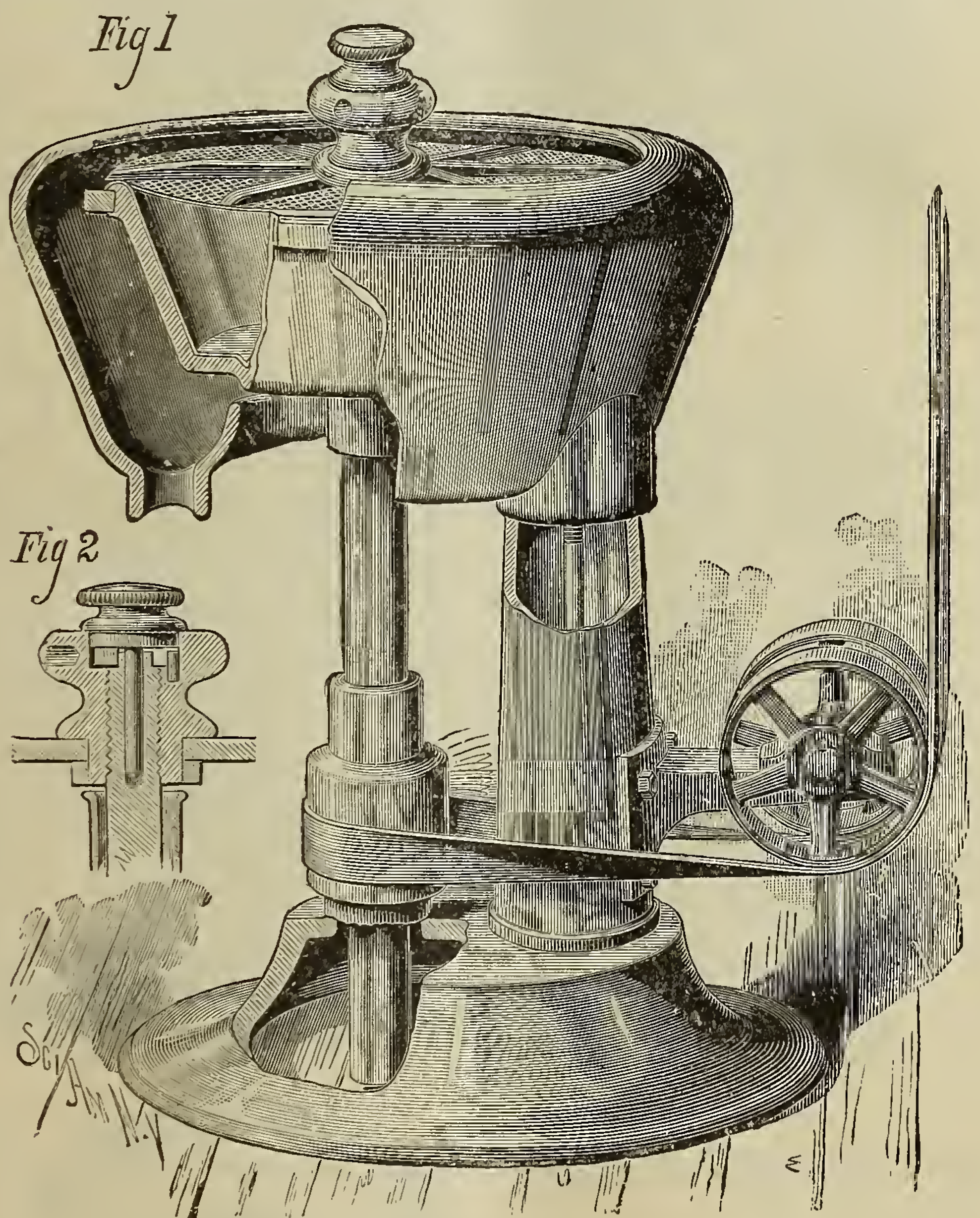
Description of carriage.	Number.	Time of arrival at Brighton. h.	m.	s.
Bollee car	35	2	30	25
Do	37	2	45	20
Panhard omnibus	48	3	46	10
A. J. Levassor's car	1	4	53	30
Panhard et Levassor	3	4	53	15
Britannic bath chair	22	4	57	10
Daimler phaeton	5	...	...	...
Pennington tricycle	33	4	57	25
Bersey landau	15	5	2	0
Panhard wagonette	8	5	7	13
Anglo-French phaeton	24	5	14	45
Daimler dogcart	12	5	27	13
Bersey hansom	17	5	41	30

The time of those arriving later was not noted.

An American carriage started and made excellent time, but was for some unknown reason omitted from the official record, which is greatly to be regretted. It is difficult to form an estimate of the exact rate of speed taken by the carriages to cover any part of the journey to Brighton. The rate of speed to Brixton was very slow, but the Bollée cars must have attained a speed of 16 to 17 miles per hour, considerably above that allowed by law.

The carriages taking part were of every type and pattern, including the styles known as landau, phaeton, dogcart and tricycles, and even a bath chair.

(To be continued).



The Weston Centrifugal Oil Separator.

BOYD THISTLE, who has been associated with H. P. Ball Mfg. Co. since its inception, has taken charge of the electrical construction department of The Electrical Construction and Supply Co., of 120 Liberty street, N. Y. This company is to be congratulated in securing so able, energetic and successful a hustler.

THE WESTON CENTRIFUGAL OIL SEPARATOR.

The accompanying sketch illustrates a new style of oil separator now being placed upon the market by the Garvin Machine Co., corner of Varick and Spring streets, New York.

The large amount of oil wasted in the manufacture of bolts, screws and nuts (it being necessary to saturate the metal while being worked), has become an important item of expense to manufacturing concerns.

This device suggests economy by the means it takes of serving the object mentioned above.

"The revolving drum is within a removable pan in which the oily chips, turnings or screws are placed, the pan being removed to discharge its contents when the

oil has been turned off between it and the metal cover, locked down by a lock-nut. The oil discharged into an outer casing is delivered through an outlet into a suitable vessel ready to be used over again."

Those using this apparatus are fully assured of its saving qualities and superiority over others on the market.

We are pleased to note the change of address of our contemporary, "The Electrical Engineer." They have installed themselves in the Beard Building, Liberty street, where they enjoy more commodious quarters. We wish them luck in their new offices.

THE CHASE CONSTRUCTION COMPANY of Detroit, Mich, has just been incorporated, with an authorized capital of $25,000. The company will devote itself to construction and equipment of central station lighting, electric railways, steam and water-works plants, having just secured a contract to build the electric railway running between Cleveland and Lorain, Ohio, for the Lorain and Cleveland Electric Railroad Co., which is to be completed by June 1.

The officers of the company are, George E. Fisher, President and Treasurer; O. D. Chase, Secretary and Chief, Engineering Department, and E. N. Chase, Vice-president and superintendent of construction.

The active men in the company are pioneers in the electrical business; O. D. Chase, whose name the company bears, was electrician and superintendent of the Commercial Electric Engineering Company, while George E. Fisher was its business manager.

During the term of the Commercial Company's existence they installed 56 central station lighting plants and 167 isolated plants, in additon to a large volume of other electrical work.

The Chase Construction Company have secured the services of E. F. Mann, as superintendent of railway construction, a practical man of large experience in railway work, having superintended the construction of the immense system of the Detroit Electric Railway Company, Niagara Falls, Toronto, and a number of the Cleveland roads, covering a period of twelve years.

The company have handsome offices in the new Majestic building in Detroit, and anticipate a very active business during the coming season.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued December 29, 1896.

573,859. Automatic Telephone Exchange System. Romaine Callendar, Brantford, Canada. Filed March 19, 1896.

573,874. Drum for Electric Controllers. Samuel Harris, Johnstown, Pa. Filed October 6, 1896.

573,884. Automatic Telephone Exchange. Alexander E. Keith, Chicago, Ill. Filed September 16, 1893.

573,903. Fire Alarm. John A. McGahy, New York, N. Y. Filed April 30, 1896.

573,905. Electric Locomotive. James F. McLaughlin, Philadelphia, Pa. Filed March 21, 1890.

573,911. Electric Arc Lamp. Levi H. Page, Chicago, Ill. Filed March 12, 1896.

573,924. Fire-Alarm System. Albert C. Rogers, Plainfield, N. J. Filed January 25, 1896.

573,929. Incandescent Lamp Fitting. Alfred Swan, New York, N. Y. Filed March 28, 1896.

573,932. Electro-pneumatic Block-Signal System. Adelbert H. Thorp, Toledo, Ohio. Filed April 10, 1896.

573, 944. Fire Alarm. Asa H. West, Lynchburg, Va. Filed March 30, 1896.

573,948. Circuit Closer for Electrical Alarm Circuits. John C. Wollin, Williamsport, Pa. Filed September 11, 1896.

573,962. Searchlight. Arthur B. Colgate, New York, N. Y. Filed December 24, 1895.

573,966. Insulator Hanger. Robert Duncan, San Francisco, Cal. Filed December 31, 1895.

573,979. Apparatus for Varying Speed of Electro-motors, Ludwig Imhoff, Berlin, Germany. Filed July 3, 1896.

573,980. Railway Rail Bond. Byron Jennings, San Jose, Cal. Filed April 17, 1896.

574,005. Telephone Circuit. Charles E. Scribner, Chicago, Ill. Filed April 20, 1895.

574,006. Test System for Multiple Switchboards. Charles E. Scribner, Chicago, Ill. Filed July 5, 1895.

574,035. Method of and Means for Regulating Alternating Current Generators. Benjamin G. Lamme, Pittsburgh, Pa. Filed March 11, 1896.

574,038. Electro-plating Apparatus. Richard J. Marks, Hartford, Conn. Filed October 12, 1896.

574,045. Electric Arc Lamp. Charles E. Scribner, Chicago, Ill. Filed May 9, 1893.

574,046. Toll Box for Telephones. Charles E. Scribner, Chicago, Ill. Filed May 14, 1896.

574,065. Bulb for X-rays. John von der Kammer, Chicago, Ill. Filed March 17, 1896.

574,101. Insulator. Charles B. Martin, Schenectady, N. Y. Filed September 28, 1896.

574,117. Electric Arc Lamp. Henry A. Seymour, Washton, D. C. Filed June 10, 1896.

The Electrical Age.

VOL. XIX., No. 18. NEW YORK, MAY 1, 1897. WHOLE No. 520

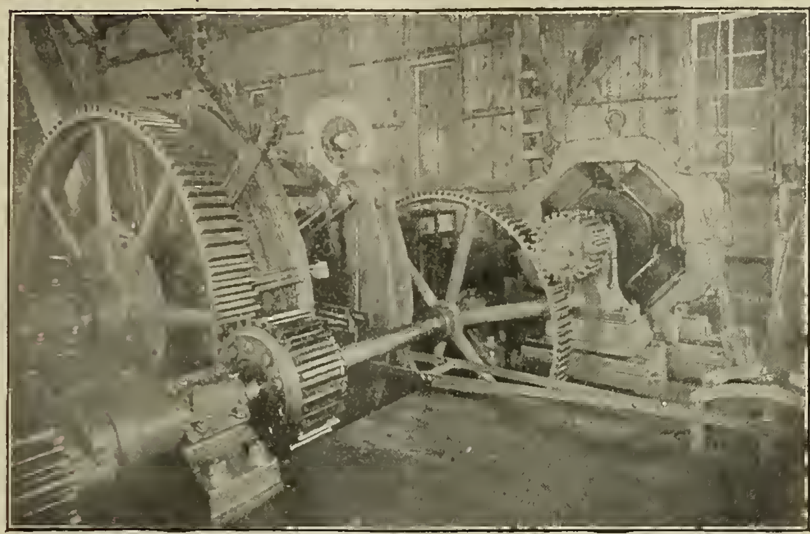


Fig. 1—Overbalanced Electric Hoist; Free Silver Mine, Aspen, Colo.

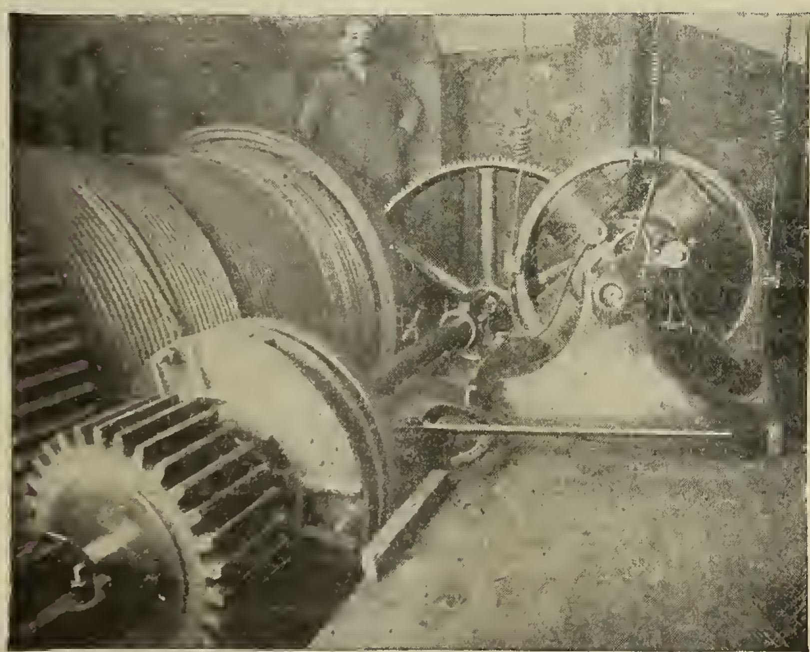


Fig. 2—Electric Hoist; Alta Argent Mine, Aspen, Colo.

THE ADVANTAGES AND USE OF ELECTRIC HOISTS.

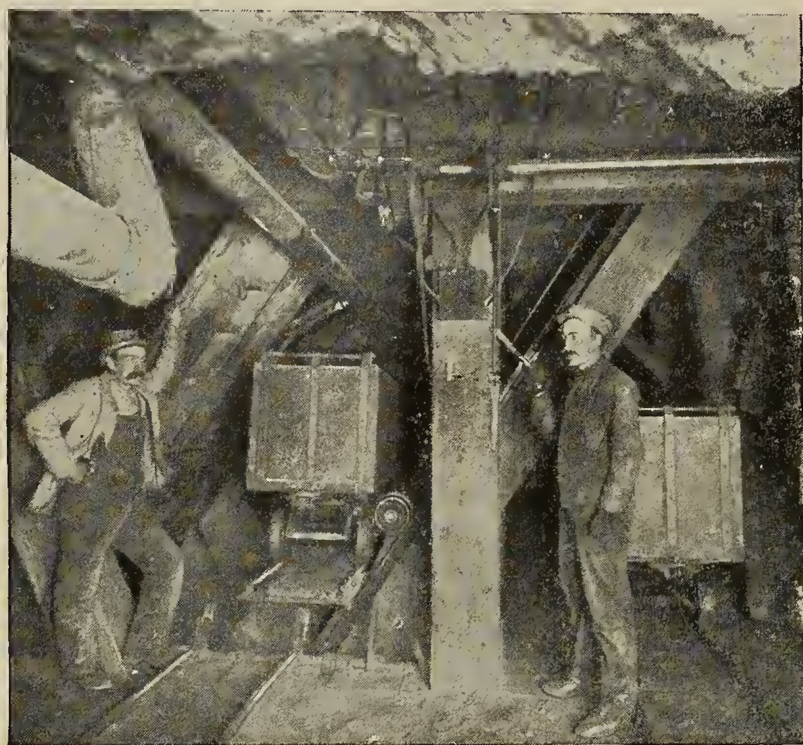
The application of the electric motor to hoisting work and the appreciation of the combination by mine operators is shown by the numerous installations of electrical hoists which have been made in mines during the past few years. In the operation of these hoists it has been found that they markedly emphasize the advantages of electrical operation. They may be located in relation to the incline or shaft exactly where they can be operated with the greatest advantage consistent with convenience of position, without any of the pipes inseparable from the air or the steam hoist. In responsiveness to the movement of the starting lever the electric motor is instantaneous. There is no short interval of hesitation, as in the steam hoist. The speed is constant and only the requisite power required to handle the load consumed, while the general cost of operation is less than with compressed air or steam hoists.

These points in favor of the operation of hoists by electricity have been demonstrated in many instances, and the following may be looked upon as affording additional evidence. At the Free Silver Mine at Aspen, Coloardo, is an electrical hoist, rated at 125 H. P., but capable of applying to the hoisting machinery power to the extent of 200 H. P. This is the largest electrical hoist in the world. It is a double-reel flat rope over balanced hoist, built after the designs of Mr. D. W. Brunton, manager of the Free Silver Mining Co., and also of the Cowenhoven tunnel, Della S., Alta Argent and Johnson Mines.

The electrical equipment consists of one General Electric Company's 100-kilowatt multipolar motor, with a speed of 550 revolutions per minute, and a smaller motor of similar type of 60-K. W. capacity and a speed of 475 revolutions. This smaller motor is ordinarily used to run an air compressor and winch for pulling pumps, but in case the main hoist-motor is called upon for heavier work than usual, the smaller one can be thrown in gear with it.

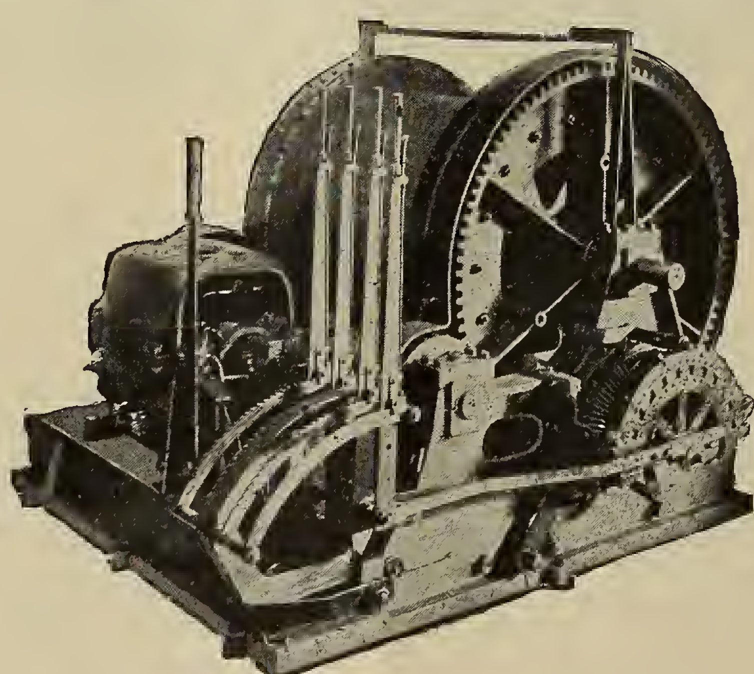
The hoist being counterbalanced, the load on the motors is reduced to about one-third of that which would be thrown on a plain hoist of the same capacity. The radius of the arms of the reels is five feet, each reel carrying 1,500 feet of rope 4-in. wide and ⅜-in. thick. The hoist is provided with a car and cage, and the loaded car and cage weigh about 5,000 pounds. As in sinking the mine it cannot be timbered entirely to the bottom, and the cage cannot go below the timbering, a bucket is hung below the cage. This is 35 inches high and about 28 inches in diameter. It weighs 400 pounds, and holds

12¾ cubic feet of water weighing 800 pounds, or rock weighing 2,000 pounds. To relieve the shaft from a sudden inflow of water this hoist is provided with a bailer, which is used as an adjunct to the pumps. This is four feet two inches by three feet two inches by eight feet four inches, and weighs empty, 1,950 pounds, and filled, 8,880 pounds. The counterweight used with the cage and bucket is 2,450 pounds; with the cage and car 2,675 pounds. With the bailer these two weights are used, making a total counterweight of 5,125 pounds. The maximum hoisting speed with the cage and ore, and using the small pinion on the motor, is about 600 feet per minute; with the bailer and using the larger pinion about 1,000 feet per minute. The voltage used is 525 volts, and the current is taken from the central station at Aspen.



Head of Incline, Alta Argent Mine. Hoist controlled from this point.

Last summer an interesting test was made with this hoist when using it for bailing. At that time the mine shaft was 835 feet deep, a depth to be ultimately increased to from 1,200 to 1,500 feet. The condensed figures showing the operation of this hoist during the test are as follows:



Electric Hoist; Pleasant Valley Coal Co., Castle Gate, Utah.

Hoisting:

Weight of bailer, 1,950 pounds; water, 6,930 pounds; total	8,880 lbs.
Counterweight	5,125 "
(Ropes balance, considering entire trip)	
Net weight raised	3,755 "
Depth of shaft	835 ft.
Work, 3755 × 835	3,135,425 ft. lbs.
Time hoisting	2.25 min.
Foot-pounds per minute	1,393,521 ft. lbs.
Mechanical H. P., 1,393,521 ÷ 33,000 =	42.2 H. P.

Lowering:

Counterweight	3,175 lbs.
Weight of bailer empty	1,950 "
(Ropes balance, considering entire trip)	
Net weight	3,175 "
Depth of shaft	835 ft.
Work, 3,175 × 835	2,651,125 ft. lbs.
Time of lowering	2.25 min.
Foot-pounds per minute	1,178,297 ft. lbs.
Mechanical H. P., 1,178,277 ÷ 33,000 =	35.7 H.P.

At the Alta Argent Mine, also at Aspen, is another hoist. This is placed at the head of the incline. The current is taken from the power plant of the Roaring Fork Electric Light and Power Co. three and a half miles distant, two miles being above the ground and one and a half miles through the Cowenhoven tunnel and mine workings. This hoist is also overbalanced and is equipped with a General Electric Company's multipolar slow speed 500-volt motor, having a capacity of 20 H. P.

The location of this hoist has been arranged with an eye almost exclusively directed to the convenience of handling the cars. The hoist is placed on a platform about ten feet above the level at the head of the incline, where the

ore cars are stopped and run off after being hoisted. Here the hoist operator stands and handles his controlling levers and reversing switch. This arrangement gets the hoist out of the way, while it allows the operator to attend to the cars. In the case of other hoists at Aspen, the hoist is placed directly at the head of the incline. This relegates the operator to the back of the hoist, where he can see both shaft and rope when hoisting and lowering. To attend to the cars he would be compelled to pass around the hoist, and as this entails loss of time, a second man to handle the cars is usually necessary. At the Alta Argent one man suffices to operate the hoist and handle the cars.

In the mines of the Pleasant Valley Coal Company of Castle Gate, Utah, is another direct-current mine hoist used for hauling the coal cars up the incline. This hoist is a Lidgerwood double-reduction single-drum hoist, equipped with a standard L. W. P. 20-H. P. railway motor and double 51 rheostat. It is designed to lift 4,000 pounds 500 feet per minute. The drum is 47 inches in diameter and 36 inches face, with two brake hands V-shaped grooves on the drums. It is provided with both friction and positive clutches, and is operated by five levers—one for the rheostat, one for the friction clutches, one for the positive clutch and two for the brake. The dimensions of the base on which are mounted the drum, motor and controller are only 78 inches by 95 inches. Another hoist of similar pattern but using a friction clutch only, and a G. E.-2,000 motor with a double 83 rheostat has recently been added to the very complete mining equipment of the Pleasant Valley Coal Co. The motor in this case is fully enclosed.

The three hoists just mentioned are in the West. In the mines of the Lehigh Valley Coal Company, at Maltby, is the direct-current electric hoist shown in the illustration, very similar to that at the Castle Gate Colliery. The dimensions of the drum are the same; the G. E. motor is of similar capacity, but the controller is of the N. R. type with packed ribbon rheostats mounted separately from the base. It is designed to hoist 5,000 pounds at a speed of 500 feet per minute.

All these hoists are and have been in constant service for months without serious hitch or stoppage beyond those necessitated in ordinary mine service. They have been found superior to steam hoisting engines, both in efficiency, in simplicity, in convenience and in speed of operation, and no better proof can be adduced than that, in the three first mentioned cases the first hoists have induced orders for additional ones.

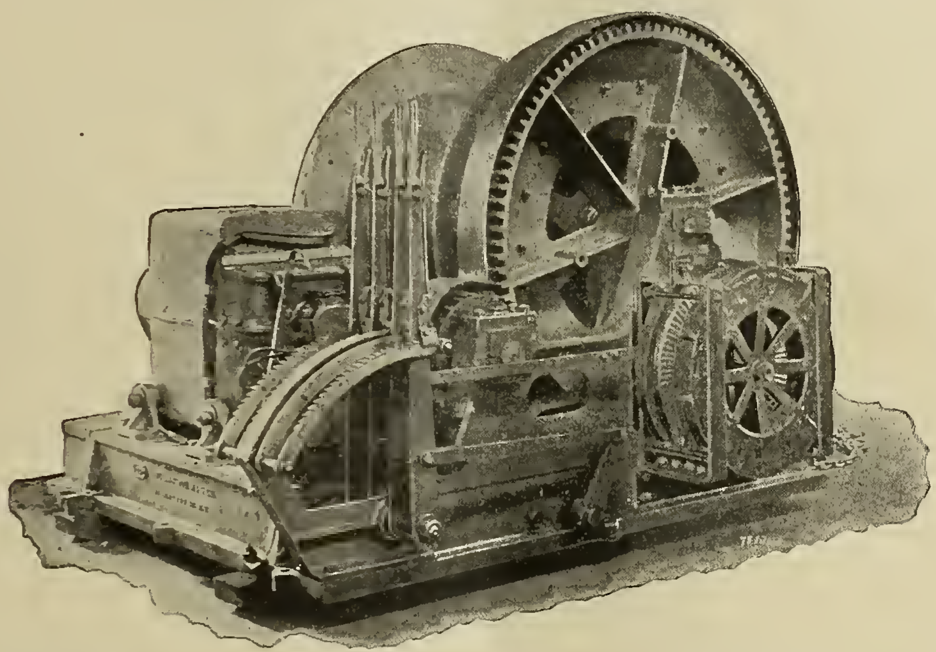


Fig. 5. Electric Hoist, Pleasant Valley Coal Co., Castle Gate, Utah.

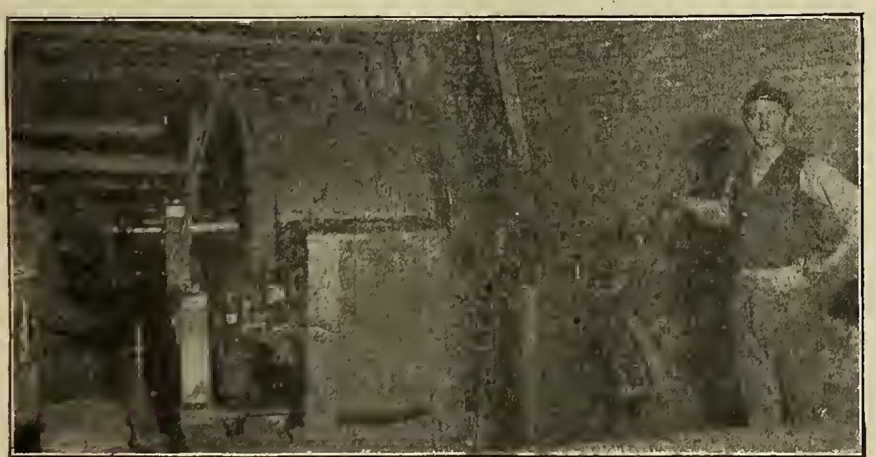


Fig. 6. Electric Hoist in Maltby Colliery, Lehigh Valley Coal Company, Wilkesbarre, Pa.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the 115th meeting of the Institute held April 21 a paper was read by Dr. A. C. Crehore and Lieut. G. O. Squier on The Synchronograph: A New Method of Rapidly Transmitting Intelligence by the Alternating Current. On account of the length of the paper and the time occupied in its illustration by lantern slides, the discussion was postponed until the annual meeting, May 18.

Ralph W. Pope, Sec.

Irvington, Ind.—An electric light plant is to be established. Bids are being invited for same.

Montpelier, Vt.—City Clerk may be addressed concerning construction of proposed electric road.

Portland, Me.—The Sanford & Springvale electric road surveys for proposed extension to Cape Porpoise has commenced.

THE INFLUENCE OF HEAT TREATMENT UPON THE MAGNETIC PROPERTIES OF HARDENED STEEL.

(Continued from Page 260.)

Steel heated to a high temperature below the point of recalescence and suddenly quenched, will very easily lose its magnetism. This seems to me of practical importance. The maximum and induction being the same, the remanence a great deal smaller than in the ordinary state, it is apparent that the hysteresis loss will be much smaller, and therefore very mild steel, as our ring III, treated in the way indicated above, is preferable to the ordinary mild steel used in transformers or other instruments, in which cyclic processes take place.

Since the hysteresis loss has been found to increase appreciably in transformers after they have been used for some time, it is of great importance to investigate whether a similar effect takes place in steel treated in the manner suggested. A series of such experiments seems to me very valuable from a practical point of view.

In 1890, Osmond (*Phil. Mag.* 29, 511, 1890) advanced a theory according to which a bar of steel consists of an intimate mixture of α iron (magnetic) and β iron (unmagnetic). He considers the β modification as forming in a steel a porous framework, the ratio between the amount of α iron and β iron not changing under the influence of currents and of magnets. "In the presence of the rigid network of β iron the polarized α particles are conceived as catching in the pores of the β structure and immovable in this position, thus resulting in a permanent magnet." Moreover, he supposes the temporary induction and the remanence to be a function of the ratio $\frac{m}{n}$, where m is the percentage of α iron, and n the percentage of β iron in the steel." Let mp and np (Fig. 1) represent the corresponding values, then the maximum induction is proportional to mp, the residual to mr. Further, supposing that the fraction of the maximum induction forming the remanence (r) is proportional to the amount of β iron (n), he derives the formula

$$r = K\left(m - \frac{m^2}{100}\right) = K\left(x - \frac{x^2}{100}\right)$$

Then the remanence is represented by a parabola starting from O upward and meeting the X axis at a point corresponding to 100 per cent. α iron.

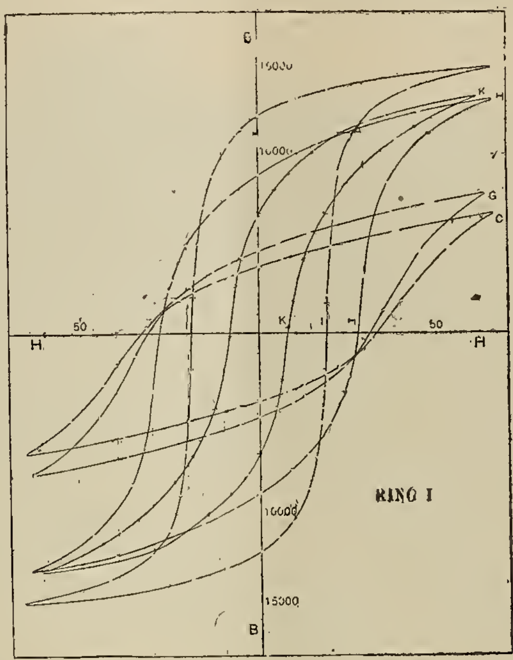


PLATE 1.

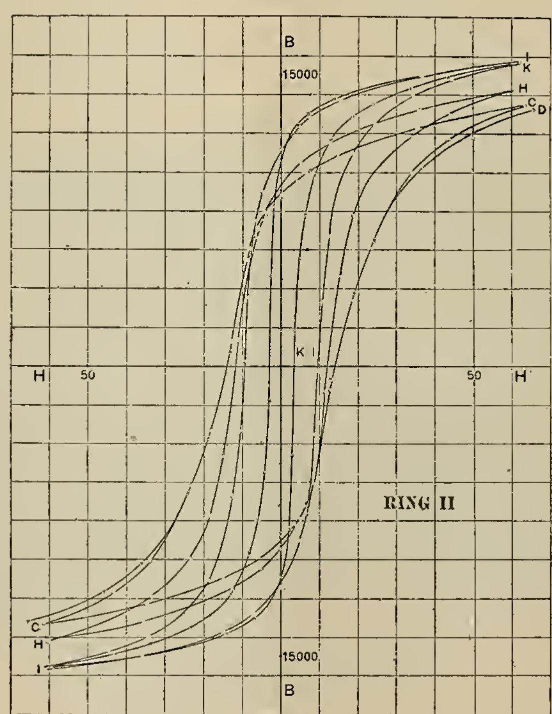


PLATE 2.

Suppose this theory to be correct, then by a change of β iron to α iron the difference between the maximum induction and the remanence increases. My experiments show that this does not take place by reheating the hardened steel. (Compare results represented on plates 4 and 5.) On the contrary, the difference becomes smaller. We cannot assume a transformation of α iron to β iron, since the permeability increases decidedly on reheating. On the other hand, the sudden drop of the remanence observed before the point of recalescence is reached would correspond very well to Osmond's theory, if we suppose a transformation of β to α iron has taken place.

I believe that we have also to take the influence of the carbon compounds into account, which has not been done by Osmond. Let us assume that the reheating has such an influence on the iron and the carbon compounds as to decrease the area between the maximum induction and the remanence, and that the rate of this change decreases, the higher the temperature to which the rings are reheated. My theory is supported by the curves showing the change in iron on plate 4. This change, whatever it may consist in, first masks the other if it is present at all. Then after the former is completed, a further heating will show the characteristic influence of the transformation of the β to a iron, showing itself in the decided lowering of the remanence.

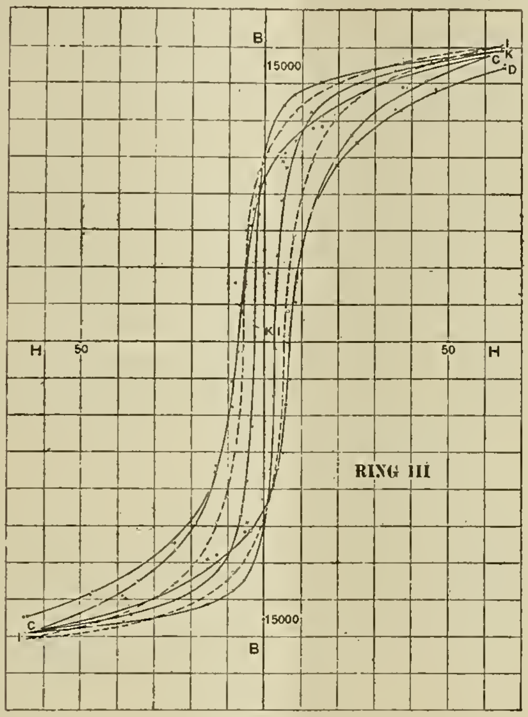


Plate 3.

4. Reheating has in general a softening effect upon the magnetic properties of hardened steel, i. e., the permeability increases, and is accompanied by an increase of maximum induction and a decrease of the coercive force. But a hardening is noticeable in the low carbon steel after it has been reheated for a short time to 100°. The greatest change in the maximum induction takes place for high carbon steel between 200° and 300°, for low carbon steel between 300° and 450°, beyond which temperature there is hardly any change in the practical limit of saturation. All change taking place in reheating beyond 450° consists in an increase of permeability for small magnetizing forces, *i. e.*, a decrease in the coercive force or hysteresis loss.

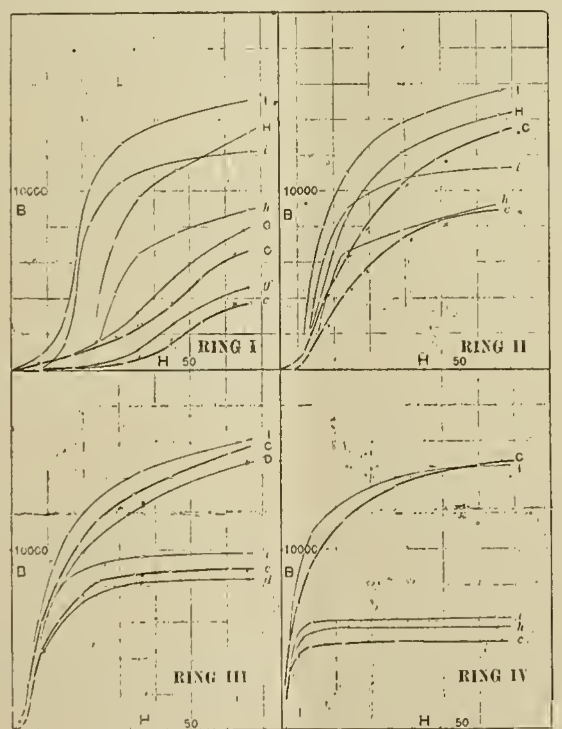


Plate 4.

The results of this research may be summarized as follows:

1. The point at which steel becomes magnetically hardened by quenching lies at different temperatures, according to the amount of carbon contained. It is considerably lower in high carbon steel than in low carbon steel, and corresponds closely to the different temperatures at which occurs recalescence of steel.

2 The higher above the point of recalescence steel is heated before being quenched, the harder it is magnetically.

3. The magnetic hardening produced by quenching is the larger, the higher the percentage of carbon.

5. To produce strong magnets the hardened steel should first be reheated to 450°.

6. Heating to a high temperature below the point of recalescence and sudden quenching produces a steel with a very weak retentivity; in consequence of which the hysteresis loss in a cycle is greatly decreased. Th s result may also be obtained, though in a lesser degree, by annealing at a very high temperature.

I am greatly indebted to Mr. L. F. Morehouse, one of my students, for the valuable assistance rendered me in most of the experiments.

Physical Laboratory of the University of Michigan,
March 13, 1897.

THE AMERICAN INSTITUTE FAIR.

The directors of the American Institute are actively preparing for what they mean to be the best show ever given by their institution. The next fair, which will be the sixty-sixth, will be held at Madison Square Garden. It will continue for six weeks. The dates have just been fixed. They are Monday, Sep. 20, to Thursday, Nov. 4, inclusive.

The board of trustees has chosen Mr. Alfred Chasseaud to be the managing director of the fair. Mr. Chasseaud was selected, from among several candidates, for his executive ability upon his successful record in connection with several expositions and fairs held in the Garden and elsewhere. The Institute has established and will, until the close of the fair, maintain a temporary office for the managing director in the tower of the Madison Square Garden.

Mr. Chasseaud is planning to amplify the departments that have become regular features of the American Institute fairs, and will inaugurate several new departures. The flower show, which has proved a good attraction, will in particular, be greatly strengthened and extended. There are likely to be innovations in the way of exhibits from foreign manufacturers. Cooking lectures on novel lines will be a feature and a special effort will be made to secure all possible illustrations of new machinery, inventions, industrial and chemical processes.

Competitive exhibits on a grand scale of penmanship and drawing from public school pupils is a contemplated phase of the fair, which will be strictly in line with the traditions and undeviating aim of the American Institute to be a public educational institution of increasing value.

A Lesson in Economy.—Consnl Germain writes from Zurich, February 2, 1897. in regard to a plan recently introdueed in the public shools of several European cities. In Brussels, the children attending public schools were requested by their teachers to gather up, on their way to and from the school, all such apparently valueless objects as old metallic bottle capsules, tin foil, tin cans, paint tubes, refuse metals, etc., and deliver their collections daily to their respective teachers. In the period from January 1, to October 1, 1895, or within eight months, the following amounts were collected: Tin foil, 875 kilograms (1,925 pounds); old paint tubes, 100 kilograms (220 pounds); bottle capsules, 2,007 kilograms (4,415 pounds); scraps of metal, 555 kilograms, (1,221 pounds); total, 3,537 kilograms (7,781 pounds). This apparent rubbish was disposed of and the proceeds applied so as to completely clothe 500 poor children and send 90 sick ones to recuperation colonies, and there still remained quite a balance, which was distributed among the poor sick of the city.

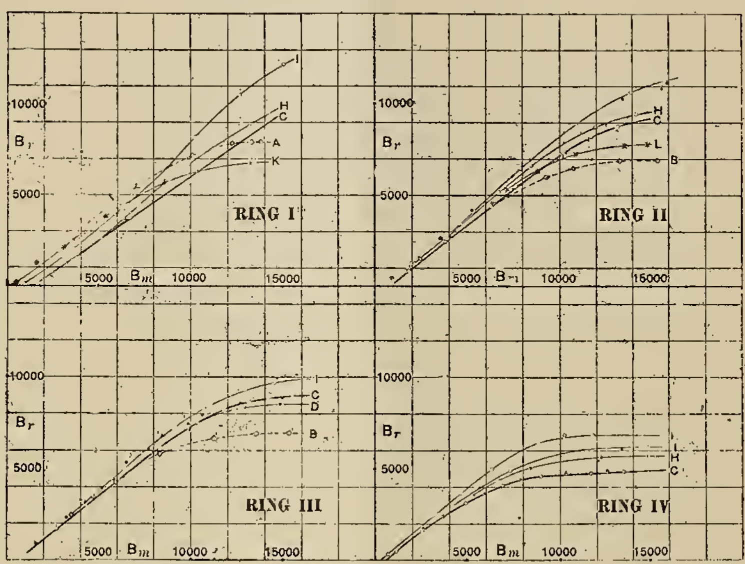


Plate 5.

The manufacture of wire is of very ancient origin. It has been traced back to the earliest Egyptian history. Specimens are in existence which can be proved to date to 1700 B. C. The Kensington Museum has a specimen which was made in Minerva 600 years B. C. Ancient literature contains many references to wire. From the ruins of Herculaneum metal heads have been exhumed on which the hair is represented by wire. There is no question that this ancient wire was made by hammering out the metal, which was always bronze or of the precious group. This held trne of all made previous to the fourteenth century, during which the process of forming wire by drawing or elongating the metal by forcing it through a conical orifice made in some substance harder than the metal treated, was invented.—The Fireman.

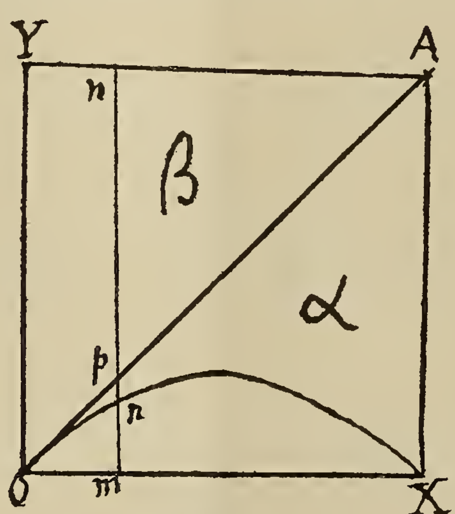


Fig. 1.

Lincoln, Me.—A new electric railroad is to be constructed from Oxford to Welchville, and survey has commenced.

Spring City, Pa.—An electric light plant will be established.

The Electrical Age.

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NEW YORK.

NEW YORK, MAY 1, 1897.

CONTENTS.

ELECTRICAL CONTRACTORS' ASSOCIATION.

The banquet given by the Association of Electrical Contractors indicates the growth of a better feeling than has heretofore existed between the contractors themselves and the underwriters and illuminating companies. They need one another in order to enjoy that felicity which springs from a recognition of common interests.

There was a time in the past when the inspection of wiring, the rules governing it and the nature of the work done was purely arbitrary. The clashes between the contractor, the inspector and the electric light company were frequent. But they now understand each other. The nature of the contractors' work, the material employed and its installation are acknowledged by all to be of the best. At the dinner, one of the speakers testified to the superiority of American installations over European. This can be attributed entirely to the "getting together" of kindred interests—the fire department, the illuminating companies and the electrical contractors.

MANUFACTURE OF DIAMONDS.

The experiments of Prof. Moissan in the manufacture of diamonds have been duplicated and improved upon by another chemist who wants to produce large gems. He differs from Moissan by enclosing the entire compound of carbonaceous material and metal within a steel cylinder. The pressure generated within this cylinder is greater than that produced in the original experiment. The diamonds are larger and more characteristic in color and appearance. The crystalline formation is governed entirely by the metal it is produced in. The shape differs if silver, iron or other metals are used. The manufacture of diamonds can be carried on on a large scale. The expense of producing them is not great, and the most conservative minded can easily understand that the production of a few large ones experimentally would almost destroy the market and future of the diamond industry.

THE LATEST ART IN BURGLARY.

The profession is being desecrated when burglars employ the electric current for the rifling of safes. The strongest and heaviest of them is no longer exempt from the onslaughts of the modern burglar. Safes that cannot be picked and whose armor is of the hardest steel fall an easy prey to the maw of the midnight depredator. If a building has electric light mains the technical burglar can smoke cigarettes while at work, for his path to crime is straight and simple.

One wire is grounded on the safe, the other with the proper resistance in series and an electrode brought in contact with the outside and allowed to burrow its way through. The metal melts and the advance of the electrode is noiseless and rapid.

The largest, thickest and most invulnerable safe ever made is incapable of withstanding an attack of this kind.

This is not given as advice to burglars, but as a caution to those owning safes.

THE VORTEX THEORY.

A word on the vortex theory may not be out of place at present. The greatest of physicists have always believed that matter is affected by a vortex motion under certain conditions—possibly under all conditions. To understand the meaning of this term—hold a glass half filled with water in the hand and begin moving it in a circular path.

The water will rotate and form a vortex. Around a wire carrying a current the magnetic energy appears as a series of vortex rings. A coil has its polarity determined by the direction those rings take. There is, therefore, a relation existing between polarity and vortex motion which is indisputable. We see in nature on a more gigantic scale the whirling planets, the first notable example that can be referred to as an indication of a tendency toward vortex motion.

Manganese Mines in Brazil.—Consul McDaniel, of Bahia, writes, February 1, 1897:

In my report to the Department of State on "Minerals and mining industries of the State of Bahia," dated December 14, 1895, I mentioned manganese ore existing near this city which had not been worked or prospected. These lands have been purchased by a company which engaged an engineer with practical experience in manganese mining to survey and prospect the mines. This engineer has just returned from his work and informs me that these mines have proven to be the richest in quantity and quality known and convenient of access, being situated about sixteen miles from the port of Nazareth, on the railroad between Nazareth and Amargosa. Nazareth is about fifty miles from this city. Mr. Grason, the engineer, estimates that over 1,000,000 tons of first-class ore are in this mine.

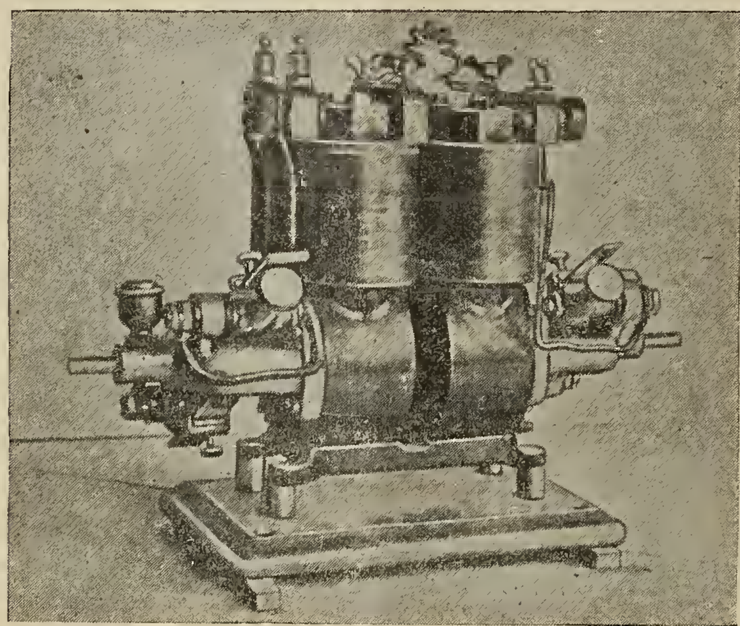
Winston, N. C.—The Fries Manufacturing and Power Co. has been incorporated with H. W. Fries, president. C. H. Fogle, vice-president, and J. W. Fries, secretary and treasurer; to establish an electric plant on the Yadkin river fifteen miles from here, to supply Winston-Salem with electric power. Capital stock $60,000.

ELECTRO-MAGNETIC INDUCTION.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

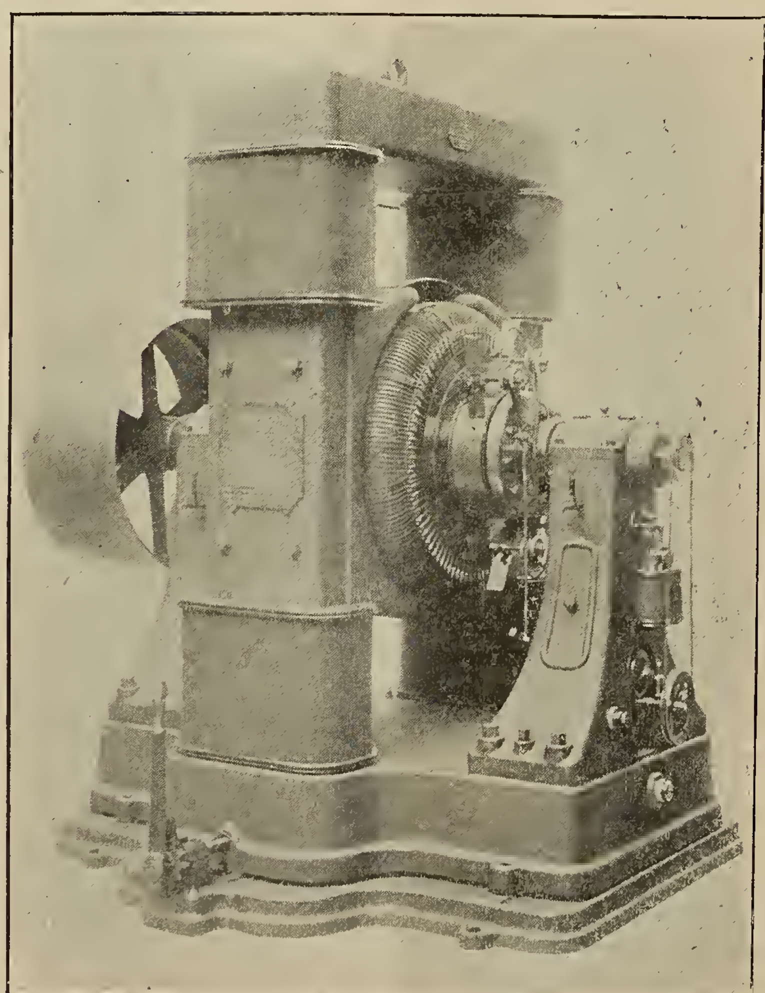
BY NEWTON HARRISON, E. E.

The many phenomena brought to our notice by the action of a current are still more wonderful when the current acts upon another. It is strange that today we are just waking up to the fact that many of the effects around us are due to the presence of an invisible and extremely fine atmosphere called ether. It is not necessary to know what ether is in studying its effects, only that its presence be remembered, and its qualities, as far as they are known. In studying the principles of electro-magnetic induction we are compelled to look upon the subject as we would gravitation; that is, in each case one body is capable of affecting the other without any visible material between. But we know that one exists, as well as we know that air, or hydrogen and oxygen are realities. It is always surprising to see one body influence another, as, for instance, a magnet a piece of iron. Yet the old effect of the earth on a stone is constantly forgotten. Familiarity with certain electrical experiments makes them lose novelty and become accepted with unconcern as the most prosaic truth to be found.

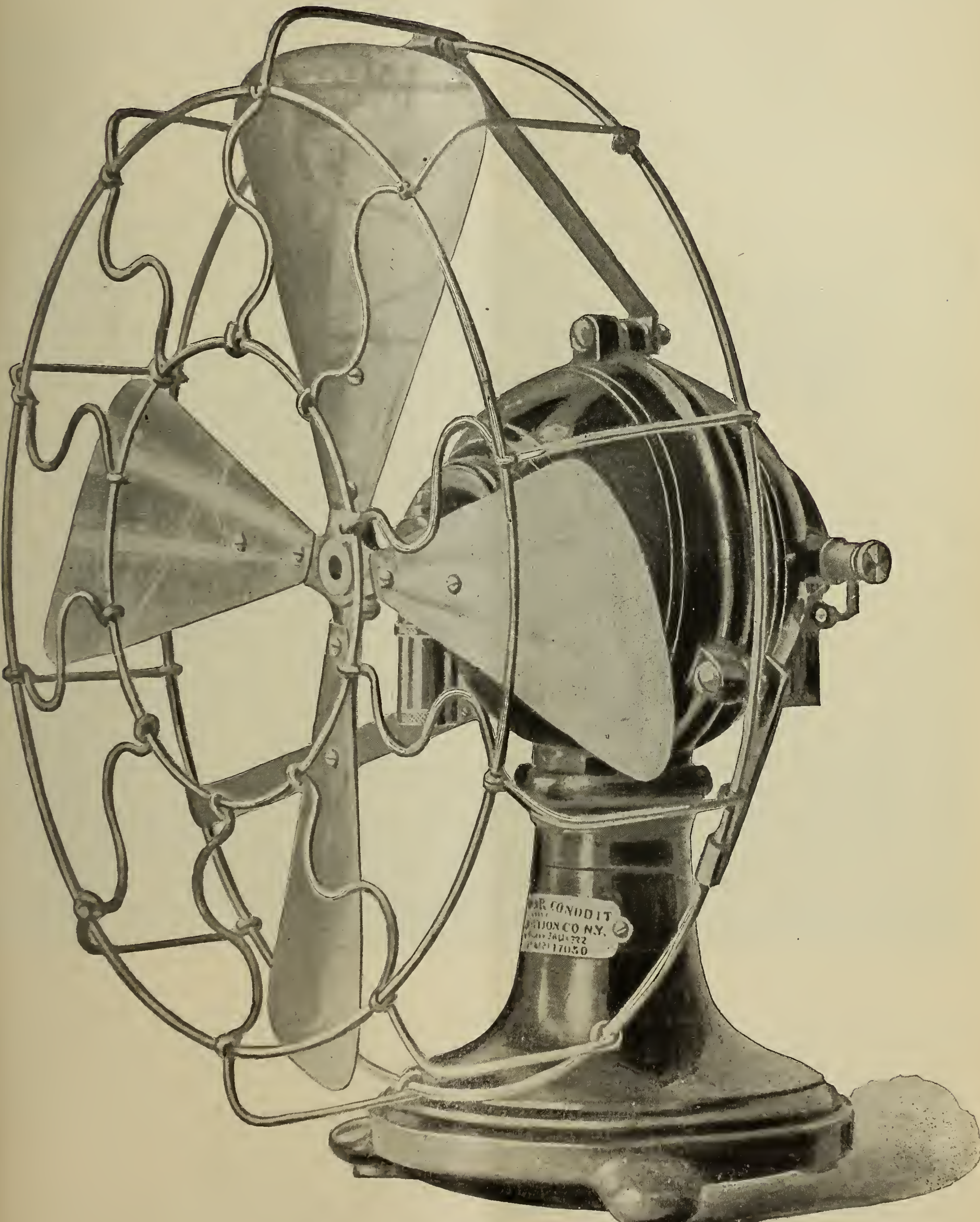


Continuous Current Transformer.

A coil of wire carrying a current becomes surrounded with magnetism. If the current changes the magnetism does likewise, and even the minutest variation is distinguishable at once. Another coil in the vicinity of the first can only be affected if these changes occur. Either the current must increase in the first coil or it must decrease; in either case, the second coil produces a current. A steady and uniform current in the first coil produces no lasting effect in the second. But when the current is started the second coils show it, and when it is stopped. Each of these changes, however, mean an increase or



Dynamo Producing Pulsating Current.



The "Standard" Lundell Direct-Current Fan Motor.

decrease of current in the first coil, and it is in these changes that the phenomena of electromagnetic induction occur when another coil is present.

Currents may be divided, according to their nature, into four kinds at least:

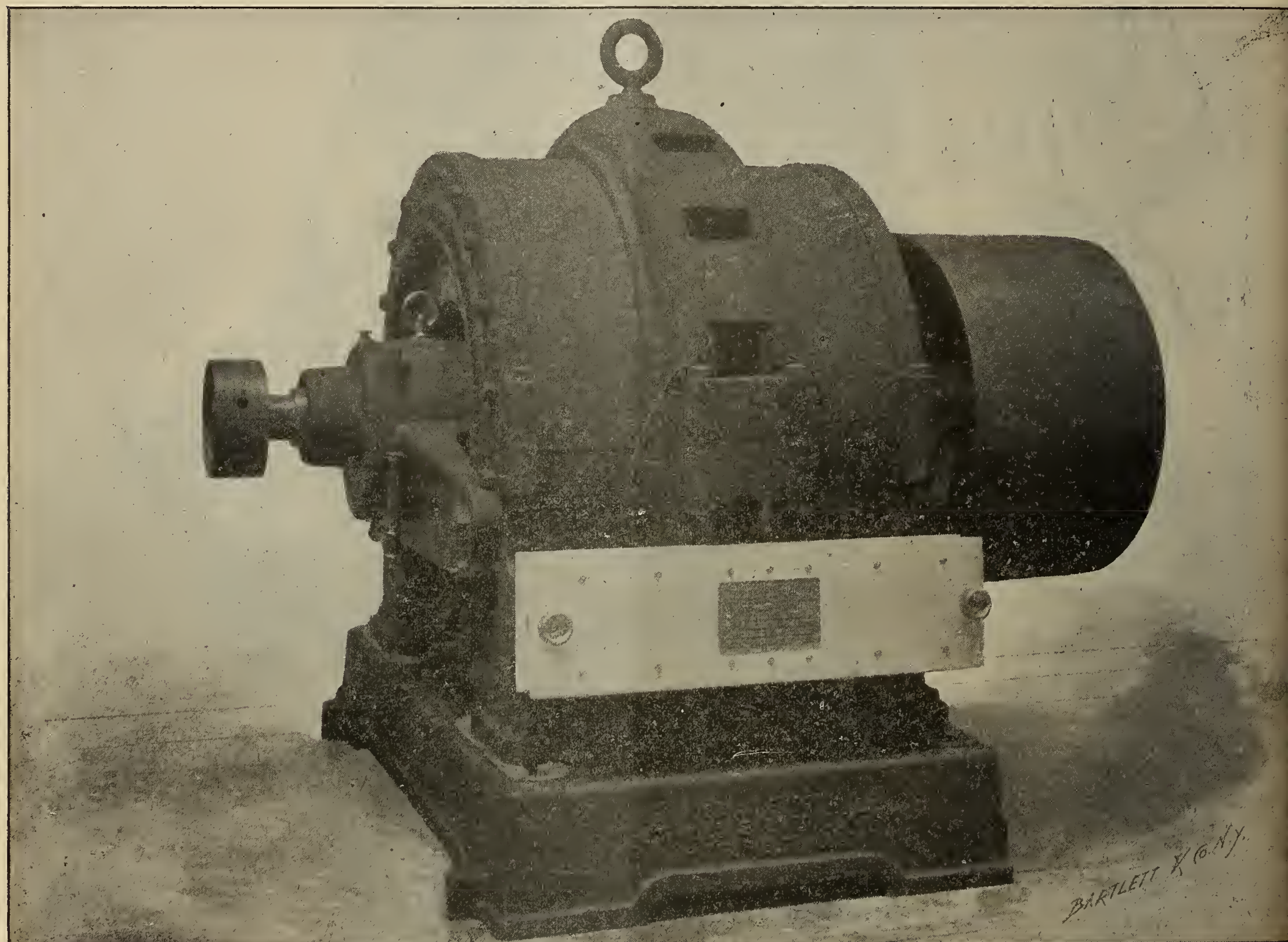
Uniform current,
Pulsating current,
Alternating current,
Interrupted current.

The coil receiving these currents will affect any neighboring coil in the same way. If it be connected to a galvanometer, the pulsations and changes can be clearly noted. The circumstances governing the intensity of this effect are deeply interesting. It is a department of neighborhood of the other and an electromotive force will be excited.

It is important that this fact be received as an absolute truth, which in any case can be depended upon with the same surety that gravitation, or the revolution of the earth, is relied upon.

An invincible principle like this is the mirror with which we reflect all other truths; it is the foundation—the stepping stone—without which further progress is impossible.

It may be understood from the last statement that either a wire moves in a magnetic field, or the field is moved in the neighborhood of the wire. We can also add that both may take place and still produce the effects spoken of. By moving a wire and a magnetic field so



Dynamo Producing Alternations.

science which touches upon a new field of facts—the study of action at a distance.

The ordinary lighting current is due to a series of pulsations, so small, however, that they appear to blend into one continuous whole. The arc-light current is a true pulsation, a rise and fall, of the current strength, but a flow which, whether weak or strong, does not change in direction. The remaining current used in commercial lighting is the alternating or sinusoidal current. It derives its name from the peculiar growth, decrease and reversal in direction. It may be observed that entirely different systems of lighting are built upon this difference between each. In the last, transforming devices are required, which have opened up a new field in the transmission and distribution of power.

The entire principle of electromagnetic induction depends upon the mutual reaction occurring between a wire and a field of magnetism. Either may be moved in the that they mutually interact, we are simply transferring the power required for that motion to the wire. The elastic material required for the transferrence of this energy is the magnetic field; the strained ether. In what direction does the current flow, and how can it be increased or diminished by this means? In other words, what limitations are there which give but a circumscribed value to the effects of all electromagnetic reactions?

The E.M.F. developed in any case depends upon the number of lines of force cut per second. If a coil is carrying a current and thereby generating a magnetic field, another coil in its vicinity will have excited in it a potential difference of 1 volt if it is moved across the streaming lines of force so that its turns and the magnetic lines give a product of 100,000,000 per second.

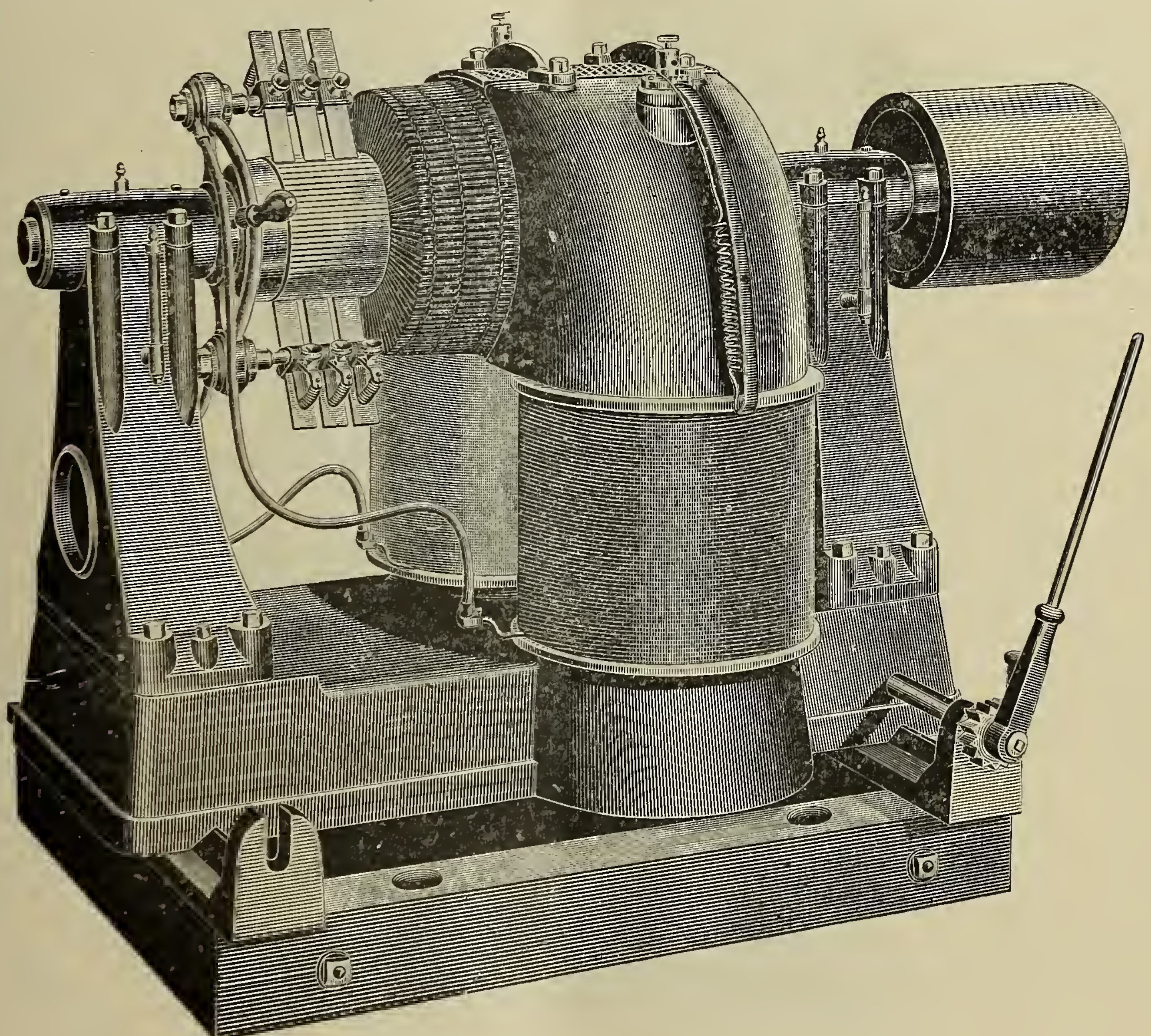
Supposing the coil to have ten turns and the field proceeding from the other coil to equal 100,000 lines of force. To excite one volt the product of 100,000,000 must be

sustained in a second. At present, with but one move of the coil, only 100,000 lines of force are cut. Therefore, the coil must be moved ten times in a second to generate one volt.

In developing this principle, the same basis is taken that all electromagnetic phenomena consist merely of interactions between a magnetic field and a coil.

For commercial purposes it is necessary that we should know the exact value of the E.M.F. developed with a given number of lines of force and turns.

In all dynamos this first conclusion practically determines the size of the machine. By following this lucid principle still further, the great department of alternating current machinery may be investigated. We have to deal in this case with a series of special devices which have, because of their peculiar nature, successfully resisted all primary is made with the proper radiating surface to admit of the rapid emission of heat. It is wrapped around in several layers of insulating tape and in some cases dipped in oil and kept there. The resistance in ohms of the primary is not the only factor which prevents the current from the dynamo injuring it. There is a back electromotive force, called self-induction, which holds the dynamo pressure in restraint. Its full effect is only felt when the secondary is supplying its full number of lamps with current. As an automatic valve, it is unequalled in its unfailing action at all times and under all circumstances. Were it not for the presence of this invisible regulator, the use of transformers could only be carried on with great difficulty. When the current flows into the primary the magnetized coil at once affects the secondary and causes it to generate an E.M.F.



Dynamo Producing Minute Pulsations.

attempts to usurp them. Were it not for the ease of transformation, the life of alternating-current systems would be very short.

But in this fact lies its strength; it is simple and convenient and in certain cases most economical. The transformer of an alternating-current system consists of a complete magnetic circuit and two coils. A ring of laminated Swedish iron with a coil on each side comprises the total apparatus.

The iron is called the frame of the transformer and the two coils, the

Primary, and
Secondary.

The Primary.—This coil is usually of finer wire than the other. It is the one which receives the current direct from the dynamo and turns it into magnetic energy. It must be carefully insulated from the iron frame and the other coil. In daily practice the primary receives anywhere from 1,000 to 2,000 volts; its function is to magnetize and demagnetize the iron of the frame. For this purpose the coil is specially designed, because it generates a lot of heat when these rapid reversals occur. The

The Secondary.—The principle elucidated now comes into direct application. The coil has been magnetized for an instant. Another coil wrapped around the iron in a similar manner to the primary is thus subjected to the influence of those lines of force the primary has just generated. If 100,000,000 of these lines of magnetic force sweep through the coil but once in a second, and the secondary consists of only one turn, the pressure developed in it will equal one volt. The design of a transformer hangs upon this fact.

Brooklyn, N. Y.—Theodore B. Willis, Commissioner of City Works, may be addressed concerning furnishing of electric lights for streets and public buildings in the city of Brooklyn.

Brookhaven, Miss.—Address the Mayor concerning establishment of electric light plant and water-works, for which an election will be held May 10, to vote on issuance of $40,000 in bonds for that purpose.

Lewiston, Me.—An electric road is to be established to connect with Mechanics' Falls.

BANQUET OF THE ELECTRICAL CONTRACTORS' ASSOCIATION.

THE courtesy extended by the Electrical Contractors' Association to the guests that attended their banquet, held on the night of April 21, will never be forgotten by them. This is the fifth annual dinner of its kind, and the members of the association can feel proud of the success that attended their latest effort. Hotel Flouret, at the corner of Eighteenth street and Fifth avenue, was the scene of unusual activity just previous to the time for assembling—the dining room was being beautifully decorated with the national colors.

The Stars and Stripes gave life and brightness to the banquetting hall, and spoke well for the patriotism and loyalty of the first organized body of American electrical contractors.

Outside blazed in Edisonian incandescence E. C. A., to show guests that the place had been reached which contained such potential happiness.

Mr. J. P. Hall gave a cordial welcome to the members and guests as the representative of the reception committee. About one hundred gentlemen took their seats at 8 o'clock to brood over the following menu :

Specification of Menu.

Cocktail or sherry (infinite). Blue Point oysters, (key receptacles). Celery, radishes, olives, Lyon sausage, salted almonds.

Sauternes, (100,000 ohms). Soups.

Petite marmite, bisque of lobster, Victoria (in outlet boxes).

Fish. Braised bass a la Barsac, (without fish wire).

Boiled potatoes, Parisienne (without C. J.)

Pontet-Canet (10,000 ohms).

Releve. Patties Egyptienne, (P. B'd).

Entree. Beef tenderloin, bouquetiere, (heavy insulation).

Vegetables. Asparagus, sauce Hollandaise, (iron armored), spaghetti a la Sicilienne, (white core).

Moet & Chandon, W. Seal, (+ ground.)

Roast. Quail on toast, (a la Fire Department). Salad, (with fixture bugs).

Liquors, (— ground).

Dessert. Pineapple a la d'Orleans (40° Centigrade). Fancy ice cream. Assorted cakes. Cheese. Fruits.

Engraving on Menu Card of Electrical Contractors' Association.

Ambrosia coffee, (no grounds). Cigars, (short circuit).

Music. The architects reserve the right to reject any or all bids.

The silken covers of the menu cards and the beautiful engraving upon each made them doubly precious souvenirs of the occasion.

Mr. Hatzel, the president of the association, sat at the head of the table, Mr. John T. Hunt, toastmaster, at his right and Mr. Eidlitz at his left.

The following speakers delivered toasts at the supper :

"The Electrical Contractors' Association," by Mr. J. C. Hatzel; "Our Guests," by Mr. E. H. Johnson: "The Fire Department," by Mr. Alexander Henderson ; "New York Board of Fire Underwriters," by Mr. W. A. Anderson; "The Illuminating Companies," by J. W. Lieb, Jr. ; "The Electrical Engineers," by Mr. C. O. Mailloux; "The Technical Press," by Mr. T. C. Martin ; "Our Creditors," by Mr. James W. Godfrey.

A little innocent vaudeville, highly interesting and clever, was given by Press Eldridge, an adept at sleight

of hand, and a pair of banjoists. The stars had ceased twinkling when the happy assemblage broke up for home.

The following comprises a list of the members and guests present:

Wm. W. Ames.	W. E. Zimmerman.
Chas. A. Mezger.	J. G. Triscuit.
Geo. W. Barthholf.	John Dale.
Thos. I. McLeod.	Edw. H. Johnson.
Wm. E. Ward.	J. W. Lieb, Jr.
J. P. Hall.	C. N. Knox.
Hon. Geo. Hillard.	C. H. Wilcox.
A. J. Martin.	C. M. Scribner.
Geo. M. Still.	Chas. P. Geddes.
Thos. F. Attix.	Chas. R. Vincent.
Francis M. Dyer.	F. S. Blackall.
Chas. L. Eidlitz.	T. Beran.
Jos. Buehler.	Mr. De Camp.
J. C. Hatzel.	T. D. Waddleton.
J. T. Hunt.	J. C. Hasbrouck.
Wm. D. Edwards.	Leonard F. Requa.
P. C. Haviland.	Jas. W. Godfrey.
Jas. R. Strong.	Frank Harrington.
W. E. Gavit.	A. V. Collins.
H. A. Sinclair.	D. W. Granberry.
E. S. Keefer.	Chas. Caldwell.
H. F. Albright.	C. K. Clark.
Sam. L. Chase.	John Williams.
Elbert Brussell.	Alexander Henderson.
Adolph Alexander.	C. O. Mailloux.
Geo. A. Haggerty.	John S. Griggs, Jr.
P. H. Klein, Jr.	R. M. Thomas.
Chas. J. Klein.	J. C. Forsythe.
H. O. Swoboda.	Arthur Williams.
J. E. Lavens.	C. A. Littlefield.
S. B. Swift.	Francis H Wall.
B. K. Sweeny.	Julius May.
Edgar L. Morley.	E. A. Van Giesen.
Jas. B. Olsen.	Wm. A. Anderson.
Max Osterberg.	W. Mc Manus.
H. B. Coho.	J. A. Connell.
D. C. Durland.	T. R. Taltavall,
Chas. T. Hughes.	(Electrical World.)
R. E. Gallagher.	T. C. Martin,
E. R. Knowles.	(Elec. Engineer.)
Wm. J. Newton.	Newton Harrison and
Chas. Blizzard.	W. T. Hunt, (Elec. Age.)
N. Y. Herald, Tribune and Sun.	Mr. Sutton.
	Mr. Grant.

The President's Address.

It seems fitting and appropriate on this occasion to give a brief resume of the history of this association and what it has accomplished. The majority of the gentlemen present are identified more or less directly with the electrical interests and incidentally with ours, in fact to a great extent our interests are mutual.

This mutual interest, in a financial way, naturally applies more directly to the gentlemen who furnish us our material and supplies; but it applies also, if only a mere matter of sentiment, to our friends the Consulting Engineers, who share largely in the credit, if their plans and specifications are carried out by the contractor to a satisfactory conclusion, and who also share largely in the general condemnation if, (so to speak) "things don't jibe."

It applies to the inspection departments of the Fire Underwriters and Fire Department, who can be saved considerable labor and stationery, in advising us of violations, if we consider our interests mutual.

It applies to the illuminating companies, who benefit us by prompt and efficient service for our customers, and are benefited by us in turn as, by our zeal to secure business, we secure them new customers and in any controversy over bills assure them of the correctness and infallibility of the meters.

And last but not least it applies to the technical press. It would be superfluous if not arrogant to attempt to define this interest on our part, and we can only retaliate by stating that, did not the electrical interests exist, there would be no necessity for the existence of the technical electrical press.

In the belief that your identity with the electrical interests may interest you in our association, a brief history of its origin, past history and what it has accomplished may be of benefit to all.

In the summer of 1892, directly after the great strike in the Structural Iron business, several members of this association now present received a communication from the United Building Trades (a council composed of delegates representing employers in the building industry) suggesting the advisability of forming an association of electrical contractors and having this association represented in this council.

This suggestion was evidently due to the fact that ours was about the only industry in the building trades which had no organization, and the desire to have all trades organized and represented in the United Building Trades, to enable employers by united and concerted action to prevent strikes and adjust labor difficulties.

Adopting the suggestion of this communication this association was organized, and it is a pleasure to state that the charter members, with one exception, are members today.

The first two years of our existence were devoted almost exclusively to the adjustment of labor difficulties, which were sufficiently numerous and harassing to prevent consideration of other objects for which the association was formed. In that time, however, the members had become thoroughly acquainted, and it is with pleasure and pride that I testify to the devotion of the members to one another in time of trouble, and to the self-sacrifice often made necessary by these labor troubles. Lifelong friendships were formed and the bitter personalities formerly indulged in and induced by keen competition were no longer heard. The belief of every individual contractor that he was the only competent and responsible party to successfully undertake and complete an installation was badly shaken, when by association he found he was not "the only pebble on the beach," but "that there were others."

While this association numerically and financially may represent a smaller percentage of the United Building Trades than a number of others, it has gained the admiration of all by its uncompromising, determined and united stand against all odds when positive it was in the right. This has been particularly noticeable in our labor troubles, when the injury of one was the concern of all.

It may be stated without fear of contradiction, that this association represents about 85 per cent. of the work performed in our industry in the metropolitan district, and naturally its action influences the trade generally.

On this supposition we have endeavored in the past few years, during our respite from labor troubles, to advance the profession, placing it on a higher plane and incidentally improve our finances. With this object in view we have endeavored with the able assistance of the consulting engineers to have proper provision made in buildings for the installation of our work, and architects generally now consider this in their plans, where formerly no provision whatever was made and the electrical contractor was obliged to utilize every crack, crevice or corner that was left over after the autocratic plumber, steam, gas and water fitter got through.

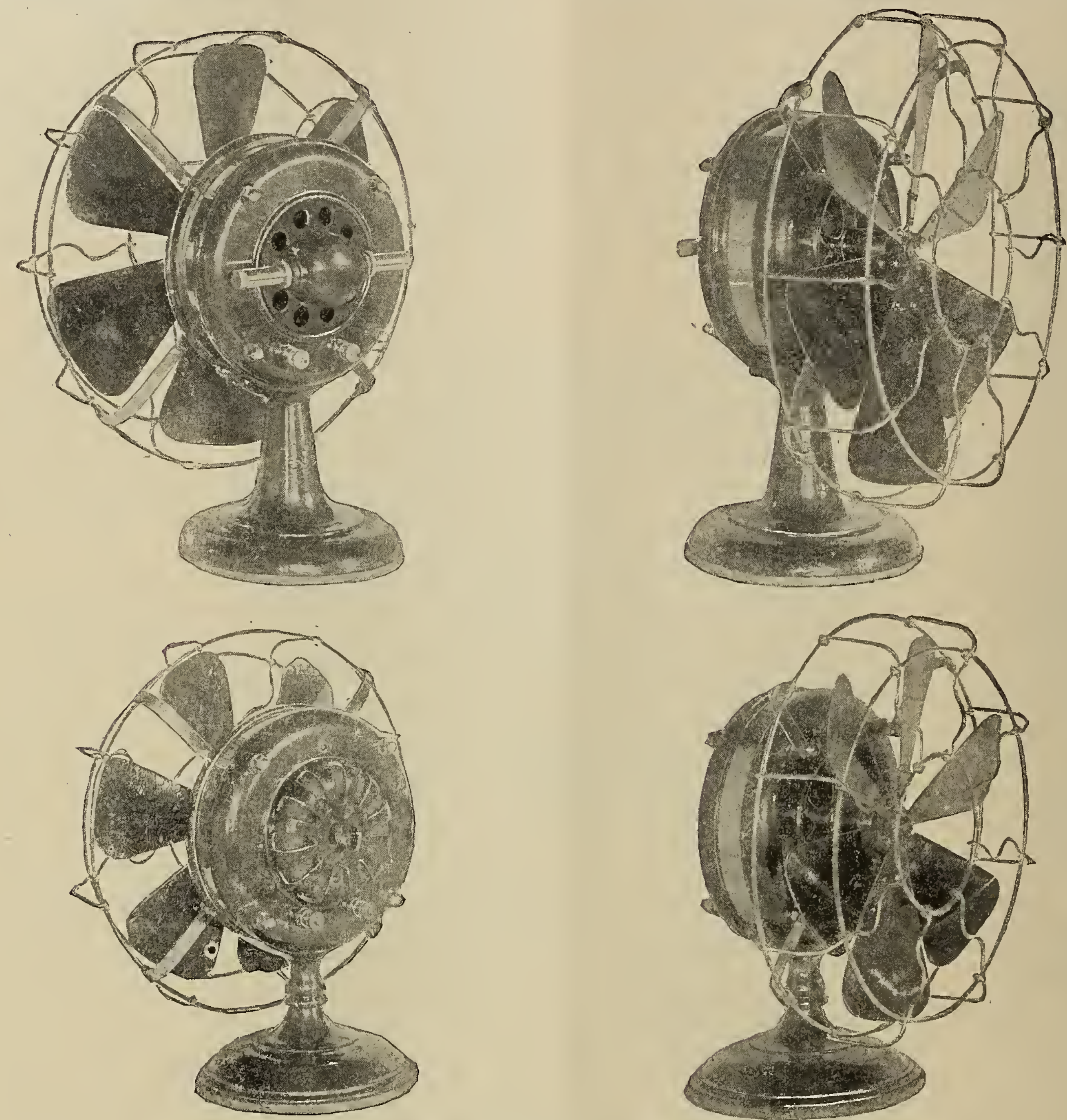
We are recognized in the formulating of new rules pertaining to our work, and this is especially true of the Fire Department, to whom we are greatly indebted through the courtesy of the superintendent and chief inspector of the inspection department.

We have established the most friendly relations with the illuminating companies.

Our relations with the manufacturers are most cordial, and we hope in the near future to induce all of them to establish a trade price and a price for customers whom they sell direct. Ours appears to be the only trade in which no such distinction exists.

THE GENERAL ELECTRIC FAN MOTOR.

The 1897 type of General Electric fan motors for direct and alternating currents have appeared on the market. The summer trade this year in "breeze producers" will probably be large and the G. E. Co. have in anticipation prepared themselves for it. These fans are built in accordance with excellent principles of design. A well ventilated armature, well balanced, made up of laminated Swedish wrought iron, and wound with conductors of the proper carrying capacity, represents a few of its essential features. The fan is well finished externally as well as internally. The details attended to on the armature find a corresponding attention on the outside. The bearings are automatically lubricated, and the fan swings through the air without any disagreeable noise. The guard is strong and well made, making the motor in total one of the most substantial on the market.



General Electric Company's Fan Motors.

(Q.)—LIGHT, MAGNETISM, HEAT, ETC.

Philadelphia, April 25, 1897.

Dear Sirs: How can you reconcile the forms of energy called heat, light, electricity, magnetism, etc., with each other? They are so different that I think it almost impossible to harmonize such differences as they develop. Your opinion would be very acceptable to

A Subscriber.

(A.)—The word energy, whose meaning is not unknown to the general reader, expresses the sum total of cause. Its forms of action are numerous, and among a few that are known are light, heat, etc. Energy cannot rid itself of the association of matter. Its medium of action is the ether, which in matter seems closely allied with it, though the ether itself is but a higher form—possibly the original and elementary form of matter; at any rate its inevitable accompanist.

Seville, Ohio.—Walter Hay desires prices of new and second-hand material for electrical light plant, such as 350 to 500 light dynamos, 1200 candle-power.

Wytheville, Va.—The Wytheville Electric Light Co. is reported to be interested in the organization of a company to build an electric street railroad.

THE VETTER CURRENT TAP.

The necessity for a current tap has been evident for years among many professional and business men.

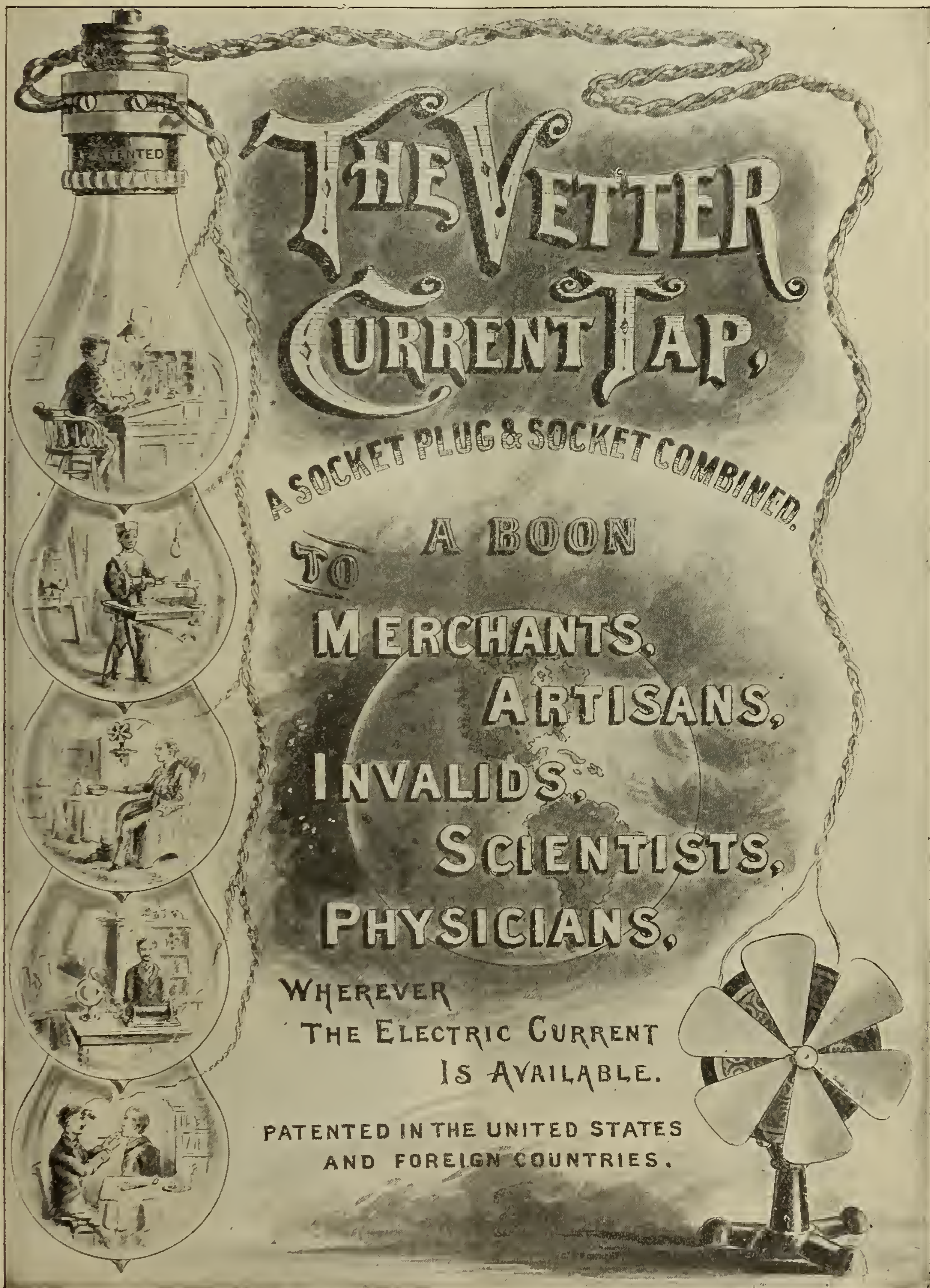
The Vetter current tap, which it is our pleasure to illustrate, is practically a socket plug and socket combined.

The sketch fully describes the general construction of the tap. They are made in two forms, parallel and series. The parallel taps have P stamped on end of brass strips leading outward. The series taps have S similarly stamped.

In any case in which current is available this tap will facilitate the transmission of it.

Its great convenience lies in the fact that the socket from which current is taken still supplies light to a lamp, both the socket and the tap being independent, yet in connection with each other.

Gardner, Mass.—The Electric Street Railway Co. are reported to have purchased ground, etc., of Westminster National Bank and will erect a power station for running the electric railway.



For offices with but few outlets it is indispensable; in the sick room, physician's office, or workshop it has earned a place. This very ingenious article is manufactured and sold by J. C. Vetter & Co., No. 104 East Twenty-third Street, New York.

Rochester, N. Y.—Alderman Calihan, Chairman Electric Light Committee, may be addressed concerning lighting of the streets with electricity.

Galveston, Tex.—Mayor may be addressed concerning the building of an electric line between Galveston and Houston.

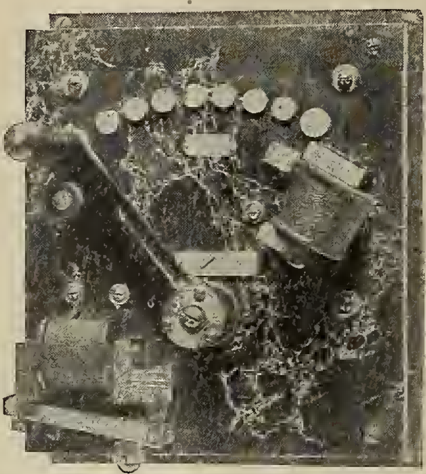
Langdon, N. D.—An electric light plant will be established.

Shelby, Iowa.—City clerk may be addressed concerning establishment of electric light plant.

Minot, N. D.—City clerk may give information concerning establishment of electric light plant.

COMBINED STARTING BOX AND CIRCUIT BREAKER.

The Cutler-Hammer Mfg. Co., of Nos. 70 to 82 West Jackson Street, Chicago, have placed upon the market an interesting and useful device which represents a combination of starting box and circuit breaker. Its application to motors for the purpose of graduating the inrush of current and likewise for preventing an unwarranted flow from occurring, needs no word from us to recommend it. The electromagnet is destined to play a most important part in the future as a basis for automatic devices of a positive character In this case we can view its dual application as the most useful part of a self-contained starting box and cut-out.



The Cutler-Hammer Combined Starting Box and Circuit Breaker.

The fine finish and absolute action of this piece of apparatus has secured for it a widespread sale. The enterprising officers of the Cutler-Hammer Mfg. Co. are Harry H. Cutler, pres. and treas.; Frank W. Smith, vice-pres.; Irving Usner, sec'y.

They are crowded with orders and hustling like a "Long Tom Express."

ALLEN BAKEWELL, vice-president and general manager of the Interior Conduit and Insulation Company, returned April 23, on the Steamer Britannic, looking hale and hearty.

E. E. F. BRADFORD. president of the Bradford Belting Company of Cincinnati, Ohio, died suddenly Friday, April 23, of apoplexy. He was well known as the manufacturer of the celebrated Bradford and Monarch belts, Monarch insulating paint and electrical supplies.

SCHIFF, JORDAN & CO. have moved their offices to 232 Greenwich street, where they are fully prepared to fill orders on demand. Their former place of business was 39-41 Cortlandt street. The highest grade carbons for alternating, direct-current and 150-hour inclosed arc lamps are always kept in stock.

TELEPHONE NOTES.

Clifton Forge, Va.—N. C. Watts, of Clifton Forge, and J. A. Sproul, of Augusta, Ga., have commenced work on the construction of a telephone system.

Newport News, Va.—The Citizens' Telephone and Telegraph Co. have been granted a franchise to construct a telephone system.

Salem, Va.—The Interstate Telephone Co. is applying for a franchise.

POSSIBLE CONTRACTS.

A movement is on foot to build an electric road from this city to Mechanic Falls and Oxford.

East Douglas, Mass.—An electric railway is to be constructed to connect this place with Worcester through Sutton and Millbury.

Greenville, Ala.—The Greenville Mills and Ice Factory contemplate putting in an electric lighting plant for city and general service, and correspondence is solicited.

Jackson, Miss.—The Mayor may be addressed concerning proposed establishment of electric light, waterworks, etc.

Augusta, Ga.—J. O. Wicker is reported interested in the establishment of a new electric light plant.

McMinnville, Tenn.—D. B. Carson may be addressed concerning erection of an electric light plant, for which bids are to be opened May 2.

The Electrical Age.

VOL. XIX., No. 19 NEW YORK, MAY 8, 1897. WHOLE No. 521

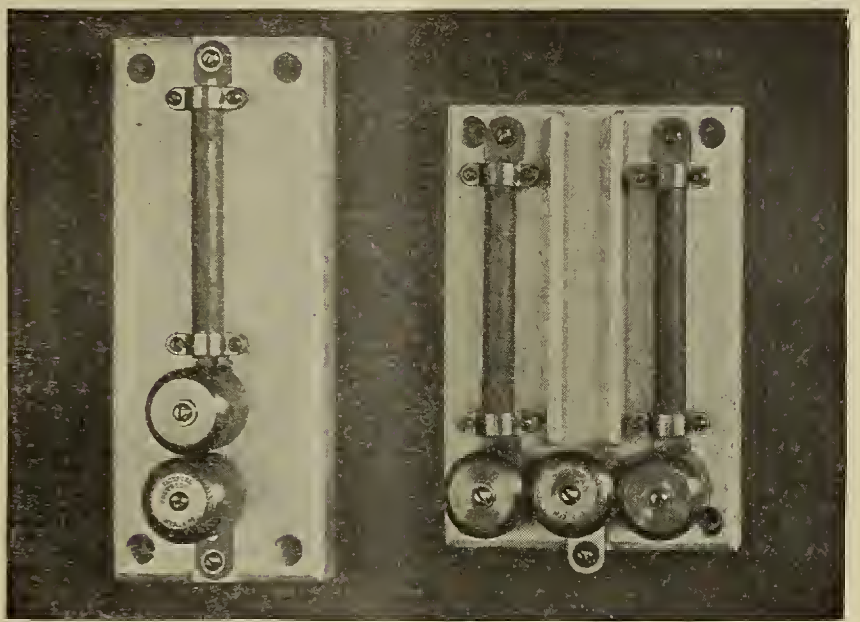


Fig. 1—Wirt Alternating Current Short-Gap Lightng Arresters.

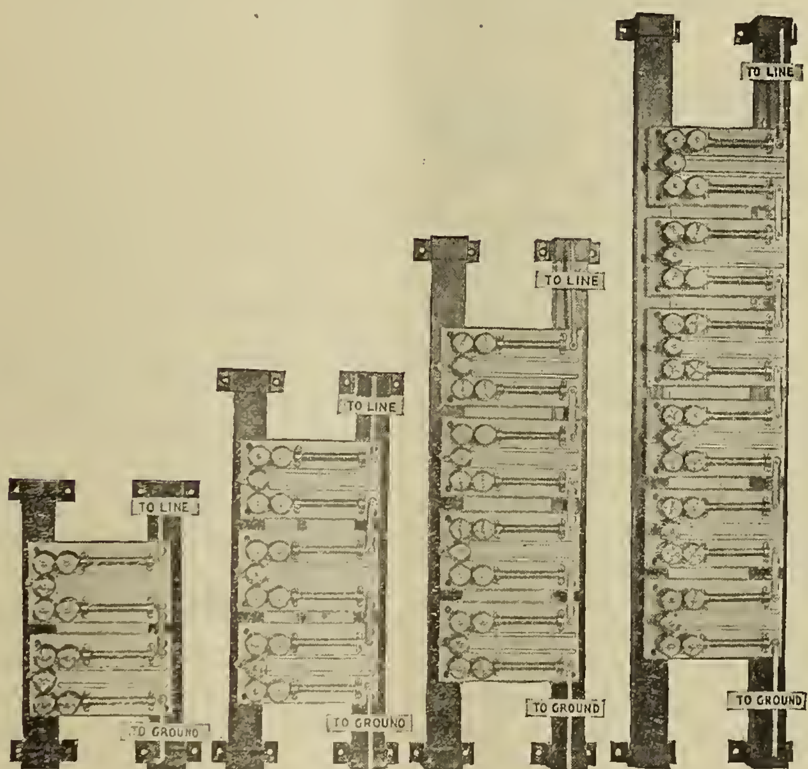


Fig. 2—Group of Wirt Arresters.

LIGHTNING ARRESTERS IN THEORY AND PRACTICE.

So many types of lightning arresters have been designed to be used in connection with overhead wires supplying alternating current that it seemed almost unnecessary to devise and manufacture a new type. Reports from central station managers, however, have shown that many arresters are more or less defective, and a great loss is consequently constantly risked and incurred on account of injury to alternators and transformers from electrical discharges.

High potential currents are generated in overhead lines by disturbances of the atmosphere and these currents may be similar to direct currents, or may have a high frequency like alternating currents. It is necessary to protect each side of the circuit with arresters, as a simultaneous discharge from each wire causes a short circuit from line to line through the ground connection of the arresters, and a slight discharge of atmospheric electricity may cause a heavy flow of current from the alternators; this would be sufficient to maintain an arc at the spark gaps in the arrester, destroying it.

The first requisite, therefore, for an arrester is, that while permitting the passage of high potential discharges, it will prevent the alternator current from following and maintaining an arc. The most ready way to prevent this is to make the spark gap in the arrester so long that the alternator will not maintain an arc across the gaps. A spark gap of several inches in length might be used, and this would be effective so far as preventing the alternator current making a short circuit. It would, however, not be effective in protecting electrical apparatus from high potential discharges, as, in order to afford protection, the arresters must be in the weakest spot of the line; that is, the potential necessary to cross the spark gaps in the arrester must be less than the potential necessary to cause the current to pass through the insulation of the electrical apparatus to be protected.

A careful record of burn-outs, due to lighting discharges, discloses the fact that they invariably occur in connection with lines protected by arresters with long spark gaps or in electrical apparatus having poor insulation.

Most of the electrical apparatus designed for operation on 1,000 and 2,000-volt circuits will barely stand a high potential test of 4,000 volts between the windings and frame of the machine. Arresters, therefore, for use on these circuits should require a low potential to cause the current to pass across the spark gaps, separating the line from the ground connection.

only showed a small arc about as large as a pin-head between the cylinders. After many successful tests the proper number of gap spaces was ascertained to be 14, with a wide margin of safety. The gap spaces are each 1/32 inch.

Arresters of this type are now standard with the General Electric Co., for all alternating current work, and a large number are already in service protecting long distance transmission power lines, having a working voltage as high as 15,000 volts.

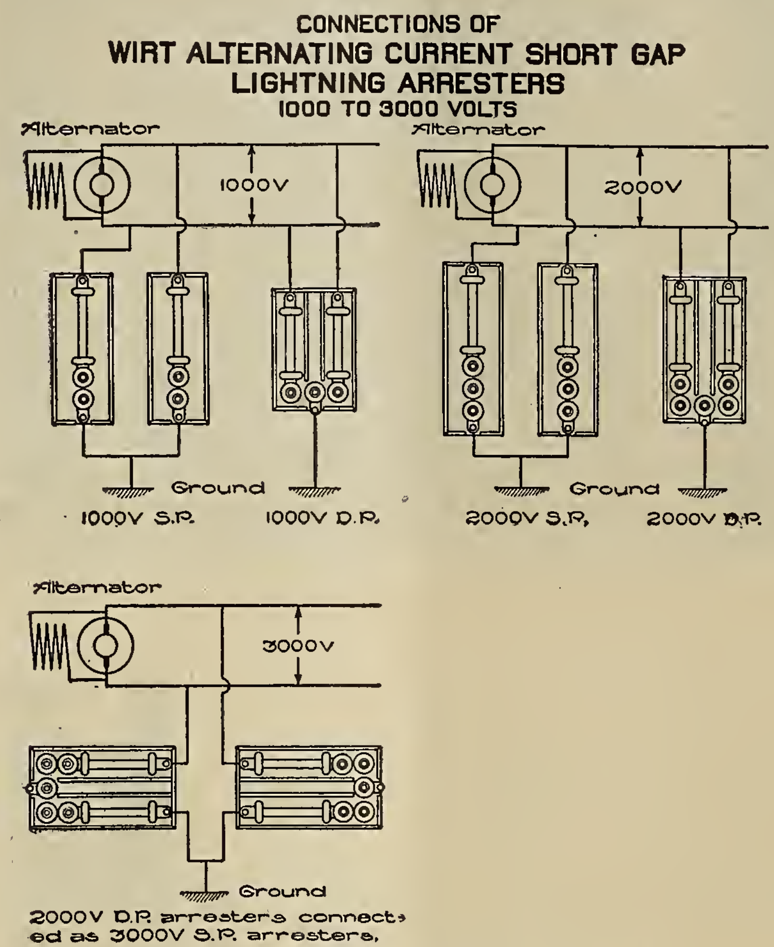


Fig. 3—Connections of Wirt Arresters.

The Wirt alternating current short gap arresters have been especially designed to operate effectively with very small gap spaces. The arrester for 1,000-volt circuits has but one spark gap of 1/33 inch between two metal cylinders 2 inches in diameter and 2 inches long. One cylinder is connected to the overhead line and the other to the ground and a low non-inductive graphite resistance is placed in circuit. The combined action of the metal cylinders and non-inductive resistance prevents the heating of the cylinders when the lightning discharge passes across the gap making the gas which would enable the alternator to maintain the arc. The arc itself is extinguished by the reversal of the alternator current. This arrester is, therefore, not an arc-rupturing device, but actually prevents the formation of an arc. The action being dependent upon the cooling effect of the large metal cylinders, which effect is increased by the introduction of a non-inductive resistance, and not upon any non-arcing property of the metal itself.

The arrester for 2,000-volt work has two gaps of approximately 1/32 inch each and a low non-inductive resistance. This arrester will not hold a short circuit when connected directly across a 2,400-volt alternating current line, but will hold an arc when tested on a 500-volt continuous current line. This proves clearly that the reversal of the alternating current itself extinguishes the arc.

The Wirt arresters are designed for use on alternating current circuits at practically any potential, the standard list including an arrester for 15,000-volt lines. For circuits above 2,000 volts the standard 2,000-volt double-pole arrester has been adopted as a unit, several of these being connected in series for high potential work.

Arresters of this type have been adopted for the protection of the power line connecting Niagara Falls and Buffalo, at the power house of the Niagara Falls Power Co. An exhaustive test was recently made to determine the proper number of gaps and resistance for a 11,000-volt, 5,000-H.P. line. The arrester under normal action

THE SYNCHRONOGRAPH.*

A New Method of Rapidly Transmitting Intelligence by the Alternating Current.

BY ALBERT CUSHING CREHORE AND GEORGE OWEN SQUIER.

In a general view of the technical history of the art of telegraphy, statistics show that at the present time, more than fifty years since the introduction of the telegraph, nine-tenths of the telegraph business of the world is transmitted by hand, in substantially the same manner as then. From an electrical point of view one naturally asks why it is, that during this period which represents more electrical progress than all times previous, the rapid transmission of intelligence has not made more advance.

It is to experiments upon a new electrical system of rapid intelligence transmission and its possibilities that your attention and consideration are invited. It is not intended to enter into a discussion here of the physical causes which have limited the speed and efficiency of the telegraph, but to acknowledge the great work of Wheatstone, Hughes, Edison, Delany and others, who have brought rapid transit to its present state of efficiency, and proceed to an explanation of the principles involved in the new system, and an account of the experiments already carried out in developing it. These experiments were conducted at the Electrical Laboratory of the United States Artillery School, Fort Monroe, where the land

* A Paper presented at the 115th Meeting of the American Institute of Electrical Engineers, New York and Chicago, April 21, 1897.

telegraph and telephone lines were available for the actual trials described.

Principles of the Transmitter.

It is difficult to treat the subject of transmitters apart from their receivers, as any particular transmitter should be considered in connection with the limitations of its receiving instrument. If we could have a receiver sensitive enough to make a distinct and permanent record of every change in current transmitted over the line, provided the line were so situated as to be free from the disturbing influences induced by external causes, it would be ideal, and the discussion of transmitters would be simplified by reducing the elements to the line and transmitting instruments alone. The qualities of receiving instruments include two principal elements. They all require a certain amount of energy to operate them, and in addition, most of them have inertia in the moving parts. A distinct advance is made, other things being equal, in the receiver which dispenses entirely with the inertia of moving parts. This is accomplished by electrolysis in the chemical receiver of Bain, which has recently reached great perfection in the hands of Mr. Delany. It is also accomplished in the polarizing receiver which was used in experiments described later.

Transmitters for sending intelligence over electrical circuits are, in every case, instruments which operate to change the strength of the current employed in the line. This includes the telephone, in which the current is a succession of waves differing not only in the frequency with which they occur, corresponding to the pitch of the tone, and in the amplitude corresponding to the loudness, but also as to the shape of the waves corresponding to the timbre or quality. The human ear is such a delicate and wonderfully constructed receiver, that it readily translates this complex wave into intelligence. If a physical instrument eould be found which would write out in visible form the exact shape of these telephone waves received, the eye might also be educated to translate them. A perfectly trained eye could detect the difference between the same words spoken by different individuals as the ear now does. Even though the waves might be accurately reproduced, the simpler the waves the less the difficulty of translating them.

The inherent distinction between telephony and telegraphy is mainly that, whereas the telephone utilizes both the frequency of the waves and their form, telegraphy relies entirely upon the duration, number, and order of arrangement of these waves, and not their form. The art of telegraphy is practically limited in this respect to three elements, or their combinations, namely, varying the duration of the waves or pulses, the direction of them, their order of arrangement, or the different combinations of these. Considering these elements separately, the first one, using waves of different duration alone for each character upon the line, is not at present used. The last method, a combination of variable duration and order of arrangement of waves, comprises the system of Morse and others so universally used, and includes the more rapid system of machine telegraphy due to Wheatstone.

There are reasons why any system using waves of different duration is not as simple as one which uses waves of equal duration, when any arrangement of make-and-break transmitter, using a constant source of electromotive force is employed. Some of the chief of these are found in the electrical properties of the line carrying the currents. The difficulties become apparent only when it is attempted to send these waves at a very rapid rate, which is desirable in machine telegraphy. The current requires time to become established at the receiving end of the line after the electromotive force is introduced at the sending end. The current wave which is sent over the line is a function of the time during which the electromotive force remains applied at the transmitter. There is evidently a practical limit to the shortness of the time which the electromotive force must remain applied, determined by the smallest wave which the receiver is capable of recording.

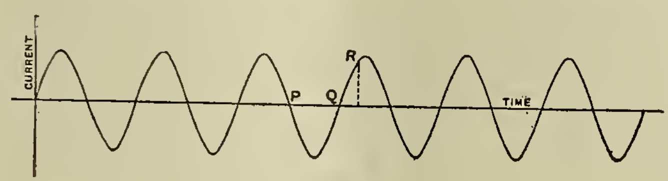


Fig. 1.

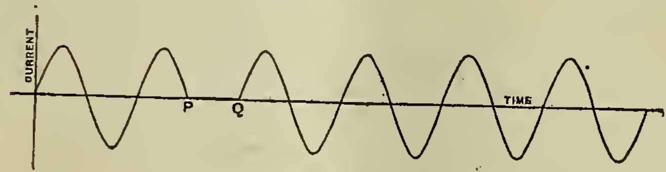


Fig. 2.

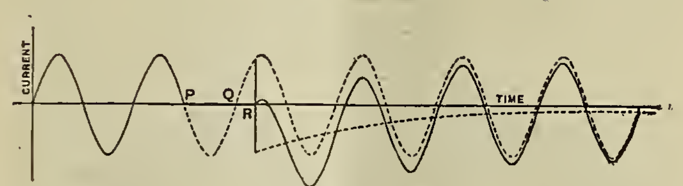


Fig. 3.

Suppose, on the other hand, that the electromotive force has acted long enough for the current at the receiver to reach its steady value, and then the circuit is suddenly broken at the transmitter. A time will elapse before the current in the receiver is reduced to zero. This case is not as simple as the former, because the manner in which the break is made must be considered. A slow break is different from a rapid one, when there is any arc, that is, a spark formed. The whole line has been charged to the limit of the electromotive force used, and must become sufficiently discharged before the next wave can be received. This produces the effect commonly known as "tailing," which means that a signal becomes so drawn out at the receiver that it interferes with the following signal.

If waves of equal duration are used, evidently more of them may be received in a given time, than of any other combination of waves, for the shortest wave may be used which will operate the receiver. With this plan, the effect of "tailing" is reduced. The use of equal waves is adopted by Mr. Delany, who also indicates by the chemical receiver the directions, whether positive or negative, of these equal waves.

The alternating current is at present successfully employed for transmitting considerable amounts of power over long distances, and the whole system is periodically subjected to a regular and uniform succession of waves rising gradually from zero to a maximum, and then gradually decreasing, reversing, and increasing to a negative maximum. Recognizing these facts, it seemed probable

that it would constitute a good means for the rapid transmission of intelligence, if the characters of a telegraphic code could be impressed upon such a current without seriously affecting its regular operation. It is to the consideration of a system of rapid transmission of intelligence by the use of the alternating current that we invite your attention.

Let the sine curve, Fig. 1, represent a regular succession of simple harmonic current waves given to the line by an alternating current generator. If the current passes through a key which may be opened or closed at pleasure, then, provided the key previously closed is opened at a time corresponding to the point P of the wave upon the horizontal axis, it is known that the current which was zero at the instant the key was opened, will remain zero thereafter, in circuits which have resistance and inductance alone. Again, if the key could be closed exactly at a time corresponding to the point Q on the curve also upon the axis, the current will resume its flow undisturbed according to the sine curve. The true current obtained by opening the key at P and closing it at Q is shown in Fig. 2, where the current remains zero between these two points. If the key had been closed at any other point than Q, as at R, the current would not have resumed its flow according to the simple sine wave; but, it can be shown, would follow the heavy curve of Fig. 3, and give a succession of waves alternately smaller and larger than the normal sine wave until after a very few alternations, when it practically coincides with the sine wave. In like manner if the key is opened at some other point than P, when therefore the current is not zero, a spark may be observed at the break, and it requires time for the current to fall to zero.

(To be Continued.)

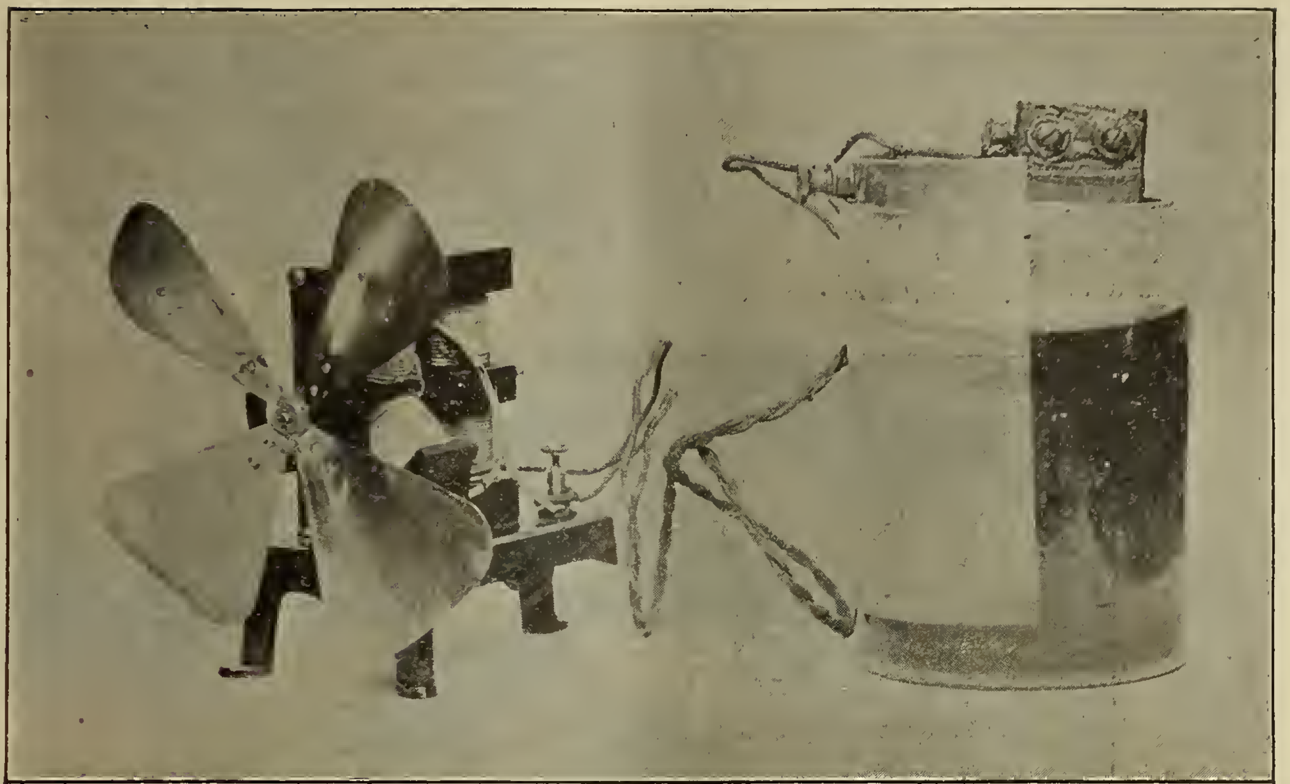
Thos. Ahearn, of Ahearn & Loper, Ottawa, Canada, the greatest electrical firm in Canada. Mr. Ahearn has just returned from an extended European trip. It is well known that firm has the largest interests in all the Ottawa electric railways as they introduced them in that section of Canada.

THE JAMES H. MASON COMPANY.

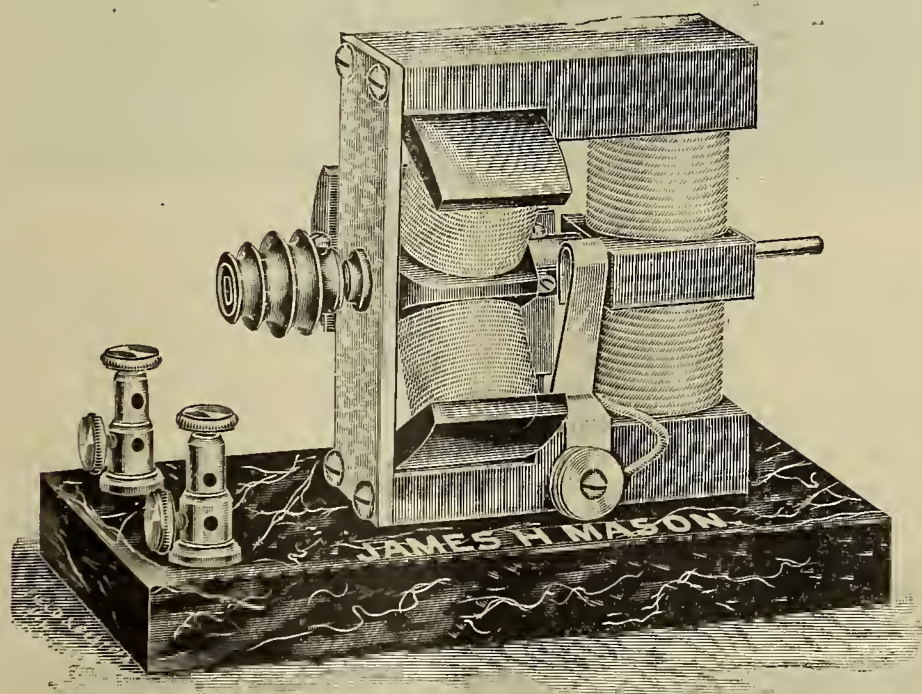
A great demand has always existed for a good galvanic cell and battery motors. To the public such a device is highly sought after, and to the man of an experimental turn of mind nothing is more fascinating. The great art of the manufacturer consists in getting out the apparatus in the most convenient form, as well as reducing its parts so that the novice can handle it, and at a figure that places it within everyone's reach. The James H. Mason Company, of 67 Liberty street, Brooklyn, N. Y., have put upon the market a superior class of goods which will touch the purchaser's heart at once. Among them is the Mason motor, which is noiseless, runs smoothly and without sparking. It is extremely simple in construction and effective in every respect. Every motor is guaranteed and will start the instant the current is turned on. Electric fan-motor outfits for use during the hot summer months are for sale by this concern. They are built for the cooling of homes, offices, stores, etc. Mr. Mason in the past ten years has gained an unequalled reputation for his work in the field of batteries and battery motors, and his specialties.

James H. Mason.

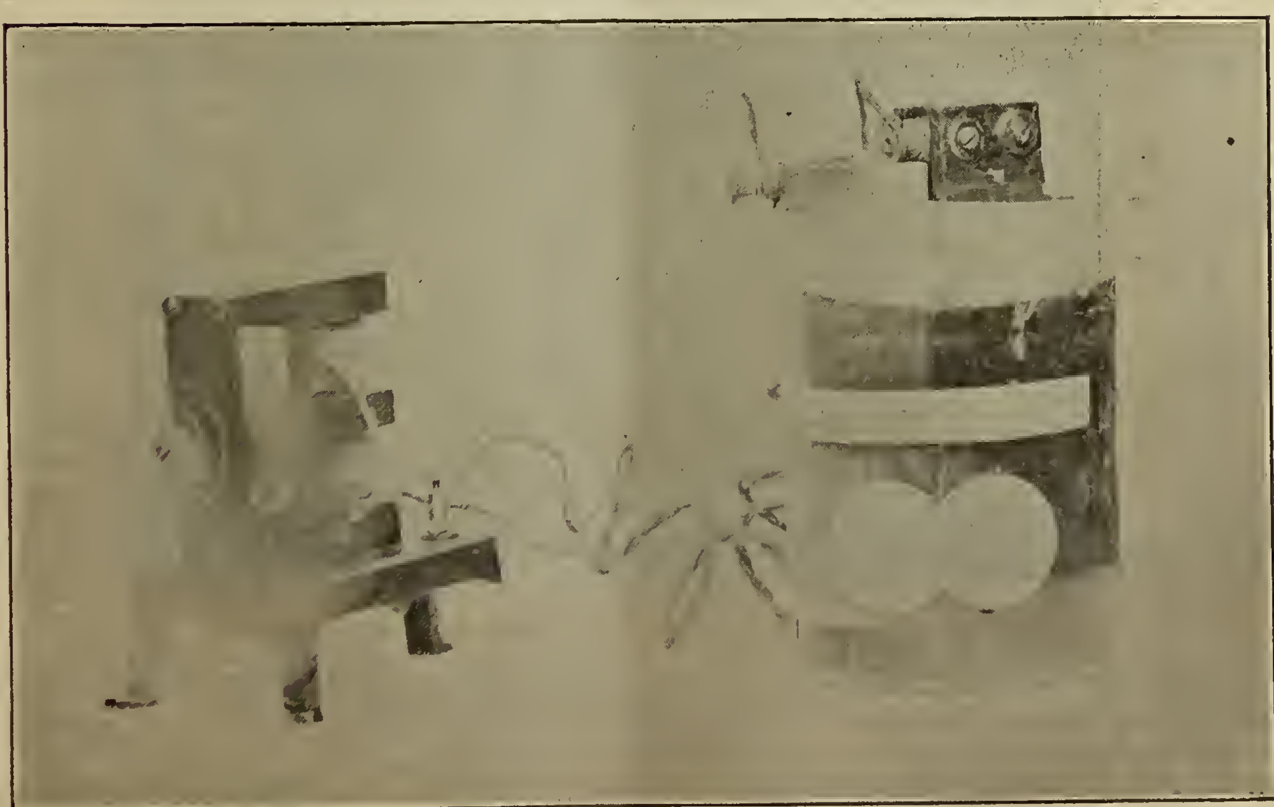
Batteries charged with the famous Mason battery powder runs the fan motor most effectively. The battery and motor outfits can be put to other purposes as well, such as the running of sewing machines and other small machinery. The James H. Mason Company sell many outfits of this description, called by the names of "outfit No. 1, 2, 3 and 4;" the largest size, No. 4, running a ten-inch fan, which is capable of sending a refreshing breeze through a large room. The Mason galvanic cell No. 9 consists of a glass jar measuring seven by five inches, and contains a specially-prepared porous cup, which is indestructible. This porous cup contains an indestructible carbon, which exposes a surface to the prepared solution of about sixty square inches, thus giving extraordinary power for such a small cell. A zinc exposing a surface to the solution of about one hundred square inches is placed outside the porous cup. This No. 9 cell is strongly recommended for small power and for small installations of light, consisting of from one to ten candle-power lamps. It takes one-quarter of a pound of Mason's



James H. Mason Co.'s Battery Motor Outfit.



James H. Mason Co.'s Battery Motor.



James H. Mason Co.'s Battery Motor Outfit in Operation.

prepared battery powder to charge the cell. This excellent cell will run a No. 2 "Mason" motor quite heavily loaded for forty hours. It will do other work under the following conditions :

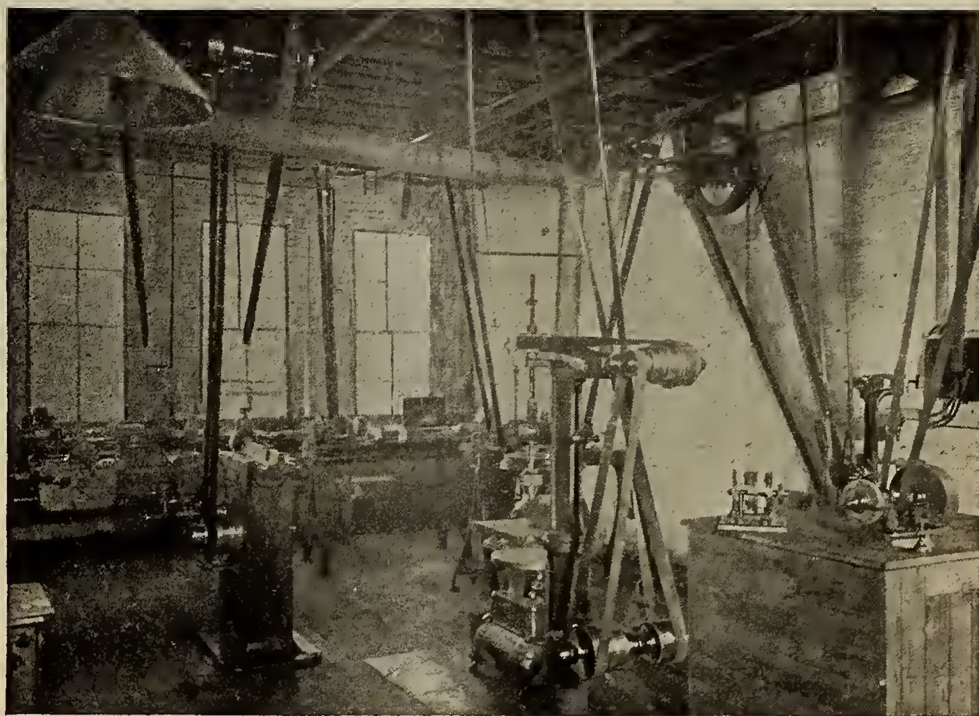
WITH ONE CHARGE OF SOLUTION.

Two No. 9 cells will run Edison phonograph	12 to 15 hrs.
Four No. 9 cells will run a 6-c. p. lamp . .	30 "
Six No. 9 cells will run an 8-c. p. lamp . .	35 "
Eight No. 9 cells will run a 10-c. p. lamp .	35 "

electrician and business man, and one who makes his customers his friends.

The thoroughly valuable properties of his battery compound have made him famous. We know of several large concerns who have attempted to copy his compound without success.

Mr. Mason is the electrician and supervisor of all the goods made by his company, so that all purchasers can depend upon receiving perfect satisfaction when ordering goods from a distance or at home.



A Corner of James H. Mason Co.'s Factory.

The light of the above lamps will be increased to an astonishing brilliancy by the addition of one or two more cells. The Mason battery solution is non-polarizing and causes no crystallization upon the carbons or formation of noxious gases. A steady current is obtainable by its use. The Mason battery powder is extremely convenient, as it only requires the addition of some water and acid, according to instructions furnished. The Mason amalgamating compound saves considerable trouble in coating the zincs with mercury, and can be used in all styles of batteries. Phonograph and graphophone battery outfits in a portable case and convenient form are always ready for immediate delivery.

The president of the Electrical Age has personally known Mr. Mason for over ten years, and always found him upright and conscientious in all his dealings as an

Mr. Mason's distinguished work in the past is shown by the gold medals he has received for superiority at the Paris Exposition in 1893, and at the American Institute Fairs of 1890, '92, '96, for his battery outfits. He received two medals of superiority, one for the battery and one for the motor at the American Institute Fair of 1896. This is sufficient recommendation for the superiority and excellence of his battery and motor.

This progressive concern is meeting with great success. Several prominent Brooklynites are associated with Mr. Mason for the purpose of manufacturing the above goods. Mr. Alexander Frazer is general manager.

View of James H. Mason Co.'s Experimental Department.

Charles A. Schieren, Jr., has been taken into the firm of Charles A. Schieren & Co., the great belt house of New York.

The Electrical Age.

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CONTENTS.

BUFFALO AND NIAGARA.

The convention at Niagara Falls of the National Electric Light Association this coming June will give many engineers a chance to carefully examine the industries carried on through the agency of water-power. They will be given an opportunity of judging of the great advantage a ready source of power is to the manufacturer and of estimating the future growth of Buffalo financially and commercially from this standpoint.

The official statement of the power contracts made shows a total of nearly 27,000 horse-power sold by the Niagara Power Co., which is but a small fraction of that which will ultimately be used as this power company develops.

According to a new monthly publication called Greater Buffalo, the total power generated at the Falls will reach the astounding figures of 750,oco horse-power, when the concerns are in full operation. The division of power is indicated as follows:

	H. P.
Niagara Falls Power Company's Present Tunnel,	100,000
Niagara Falls Power Company's Second Tunnel,	150,000
Niagara Falls Hydraulic-Power and Manufacturing Company's Canal	150,000
Canadian Niagara Power Company's Three Tunnels	350,000
Total, Niagara Falls Power,	750,000

The great grain mills of Buffalo will all be turned by electric power when it has fully penetrated the interstices of this field. Being a recognized centre for live stock and a great railroad ganglion, there is every prospect of its supremacy as a city of triple greatness.

It is within the neighborhood of Buffalo and within the limits of the picturesque and historically interesting city of Niagara that the coming electrical convention will be held. The great turbine plants with their enormous generators attached will be new and novel sights to many of the visitors.

FILTRATION OF LIGHT.

We are inclined to believe that scientists become egotistic at times. In the course of discussions carried on with great enthusiasm by men of training it became evident that many X-ray photographs were attributed to so-called light filtration. It is but just to those in particular that took X-ray photographs by means of the arc light to say, that their opinions and experiments have been justified by the work of Nikola Tesla. A man of a very practical turn of mind complained to us the other day of the recognition and hearing given to those of better scientific standing than himself when he advanced the opinion that the electrical arc produced X rays. He claimed that more attention ought to be given to results even though they are not immediateiy explainable and proceed from the experiments of other than experts. Several gentlemen somewhat prominent in scientific circles cried out loudly against the possibility of an arc producing X rays. Their remarks were prompted by ignorance and egotism. Verbal antagonism was absent, because the real reason lay in abeyance, but the results even were swept aside as worthless in a prejudiced and entirely uncalled-for manner.

Since Tesla has demonstrated the real truth of the matter beyond further discussion, the experiments of the unscientific practical men have assumed a position of greater importance, while his full-voiced opponents are preserving an unearthly silence.

The Production of Large Artificial Diamonds.—Consul Germain, of Zurich, sends, February 4, 1897, the following:

Diamonds of a very small size have been produced artifieially heretofore, but no one has as yet succeeded in producing large ones. Mr. E. Moyat claims to have discovered a new process by which to produce diamonds of large dimensions. In principle, his process is about the same as the one already invented by others, and that is to obtain crystallized carbon out of iron and coal, by means of high pressure and high temperature. Yet there is some improvement in the Moyat process as regards the technical operation. Pulverized coal, iron chips, and liquid carbonic acid are placed in a steel tube and hermetically sealed. The contents are then subjected to the action of an electric arc light by means of two electrodes introduced into the tube. The iron liquefies, is then saturated by part of the pulverized coal, at the same time the liquid carbonic acid evaporates, thereby creating an enormous pressure on the mixture of iron and coal. This pressure again considerably increases the dissolution of the coal in the liquid iron. While the mixture is cooling, the carbon crystallizes partly in the form of real diamonds and partly in the form of similar stones. These crystals are then segregated by dissolving the iron in diluted muriatie acid. The mixture, by the above method, remains under high pressure during the operation of the electric current, while by other methods the pressure is obtained later on only by means of the rapid cooling process of the crucible.

Pittsburg, Pa.—The Pittsburg and Mount Washington Railway Co. has been granted a franchise to construct a line.

Stony Brook, L. I.. N. Y.—Thomas N. Bayles will establish an electric light plant.

ELECTRICITY FROM CARBON WITHOUT HEAT.

(Continued from Page 189.)

Mr. Bradley described fully the action of fused salts on coal and stated that the oxygen of the air was absolutely necessary for the purpose of cheap oxidation, or, to use his own language:

"The cell consisted of fused sodium manganate; and putting a blast of air through it and by that means supplying it with oxygen, and allowing it to act on the coal, which is put in another part of the vessel, a little over one volt was obtained."

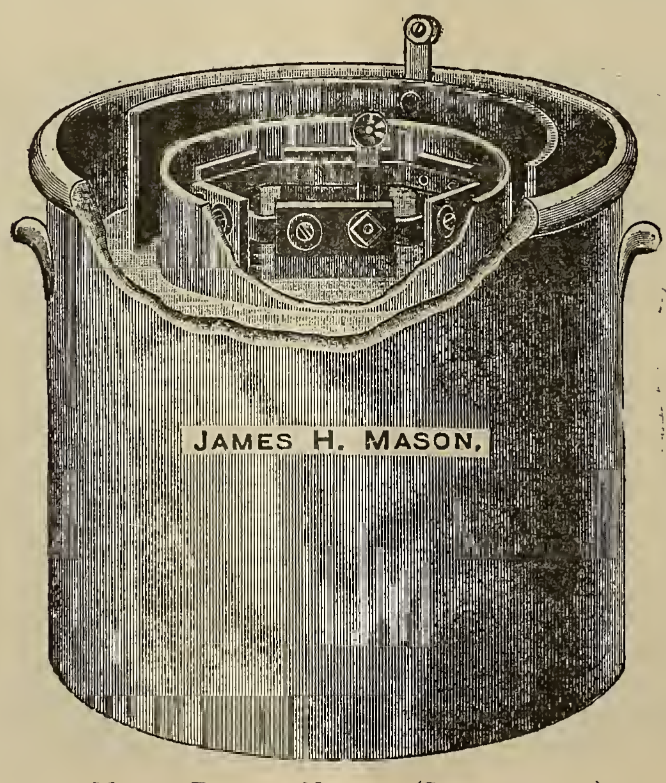
The cell consists of an iron vessel two and one-half inches in diameter and six inches deep, which is placed inside of a retort and heated by a gas flame to nearly a red heat. The electrolyte of the cell is caustic soda, to which peroxide of manganese is added, forming sodium manganate. In this cell is immersed the electrode of carbon which acts as the positive pole, and when the circuit is closed you will see that we will have an E. M. F. of about one volt, with a current of three amperes.

When the carbon rod is drawn up along the inside of the vessel the highest E. M. F. is obtained, and when this carbon electrode is replaced by another having none of the fused electrolyte on it, and brought in contact with the exterior of the vessel at different points where the temperature varies, no appreciable E. M. F. is obtained. This would indicate that as we draw the carbon up out of the bath against the side of the vessel we approach a point where the critical temperature exists and we get the highest E. M. F.

If a nickel crucible be used, as suggested by Bradley some years ago, the E. M. F. is brought up to what is considered the theoretical, as you will see. This little nickel crucible contains fused caustic soda and carbon electrode, the same as in the Jacques cell. When heat is applied, you will notice that the voltage goes up to 1.16, then begins to fall, and at a critical temperature above a red heat it drops to .3 volts—a most interesting fact—and on cooling, the voltage goes up again to 1.16 and drops again when the caustic soda solidifies. You will observe that the voltage is above the theoretical.

The next cell to which I will ask your attention is that described by W. W. Jacques in Harper's New Monthly Magazine, in December, 1896, which is another illustration of the same principle involved in the Bradley cell

Mason Battery No. 8. (See page 292.)

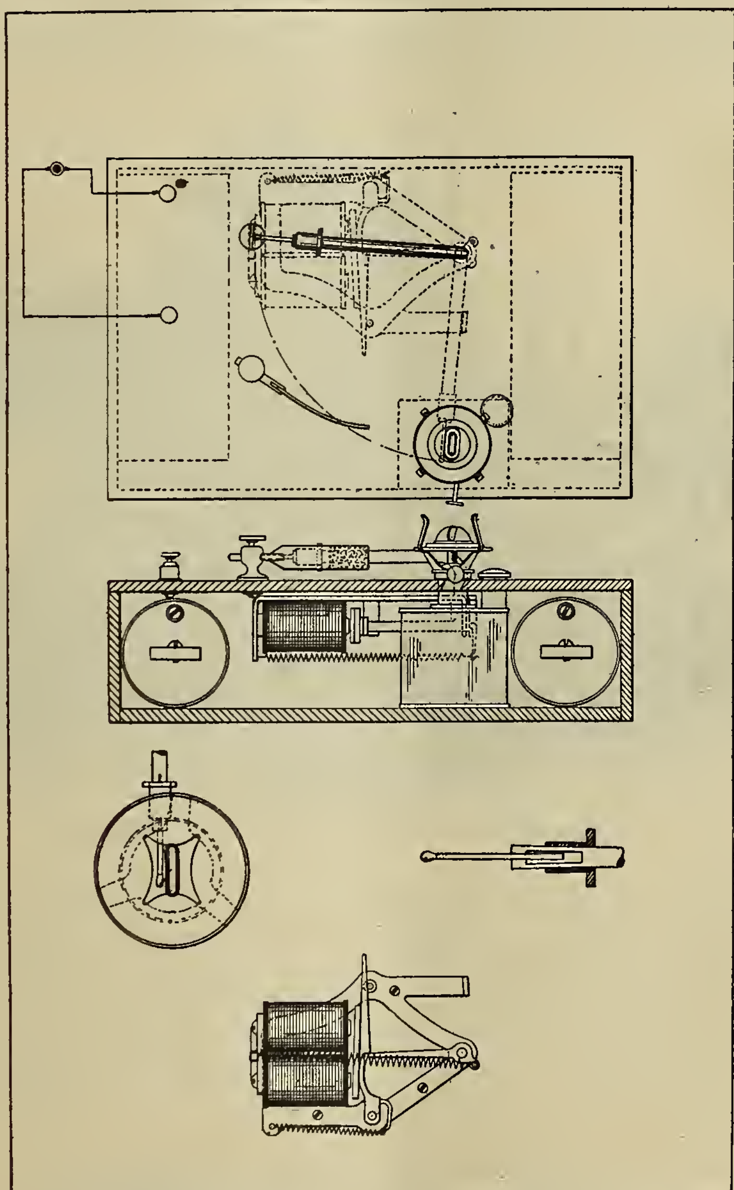


Mason Battery No. 9. (See page 292.)

with a few practical modifications. It, like the other cell, consists of an iron vessel which is the negative electrode, containing fused caustic soda, minus the peroxide of manganese, into which is plunged the positive coal or carbon. The oxygen is supplied by a blast of air as in the cell before described, and an E. M. F. of about one volt is said to be obtained. The difference between these two cells, which I particularly desire you to notice, and the only practical difference between them, is the addition of peroxide of manganese to the bath of the Bradley cell; and although I have described them chronologically, I will first show the Jacques cell, and then by simply adding peroxide of manganese to it we will have the Bradley cell.

THE ELECTRIC EMERGENCY LAMP.

Used to illuminate from a distant point by means of a fluid in combination with an electrical contact in which are employed the essential fluids to be ignited by heat, produced from a distant point, or several points remote from the point of illumination, by means of electricity. The apparatus embodying all the essential parts required to produce said results is apparent in the following description: It consists of a special burner which is adapted to a chimney within or without—smokeless in either case—and admits of ignition without removing the chimney or globe, especially for electric lighting.



Electrical Emergency Lamp. (Patent applied for.)

We will then be enabled to get their comparative E. M. F.s and current in the same cell. But I may say in passing that experience with these cells before you leads me to believe that the theory of their action is not by any means well understood. It is most uncertain and erratic, and seems to be more so before than after the addition of the manganese peroxide; for instance, its E. M. F. seems to depend upon its temperature. If water is present when the caustic soda is first used, a reverse current becomes manifest. When air is blown through the electrolyte the E. M. F is increased. Sometimes only .3 of a volt is obtained, sometimes about 1 1-2 volts, but the greatest amount of current is apparent when the carbon is immersed in the bath; and curious to say, the highest E. M. F. is obtained when the carbon rod is drawn up along the side surface of the vessel and out of the bath. If the immersed carbon rod is brought in contact with the cold exterior surface of the vessel no E. M. F. is observed.

(Experiment performed.)

Many other peculiar actions will be noticed if the carbon rod is replaced by an iron one.

(To be continued.)

We employ any ordinary match that can be purchased anywhere throughout the country; the necessary battery can be purchased at any place where electric supplies are for sale; consequently all the perishable parts are easily procured.

The match is placed in the end of the arm, which is slotted to receive it. A sleeve is pushed outward over the slotted portion of the arm, thereby securing the match firmly to it, as shown in the cut. The arm is bent at right angles and passes through the frame, in which it is allowed to turn freely. At or near its lower end is secured a trip lever, to which is attached a spiral spring, the other end of which is attached to the frame for the purpose of swinging the arm. A flat steel spring having its inner surface roughened, not unlike a grater, is slightly within the radius of the sweep of the arm and match. As the arm is drawn around by the spiral spring the match is brought in contact with the roughened surface of the steel spring, is ignited and passes under the lamp burner, which has a peculiar vent-hole admitting the flame of the match into the combustion chamber, thus lighting the lamp. The arm can then be readjusted and a fresh match inserted ready for further use.

The above device is the invention of Mr. Gillette, who

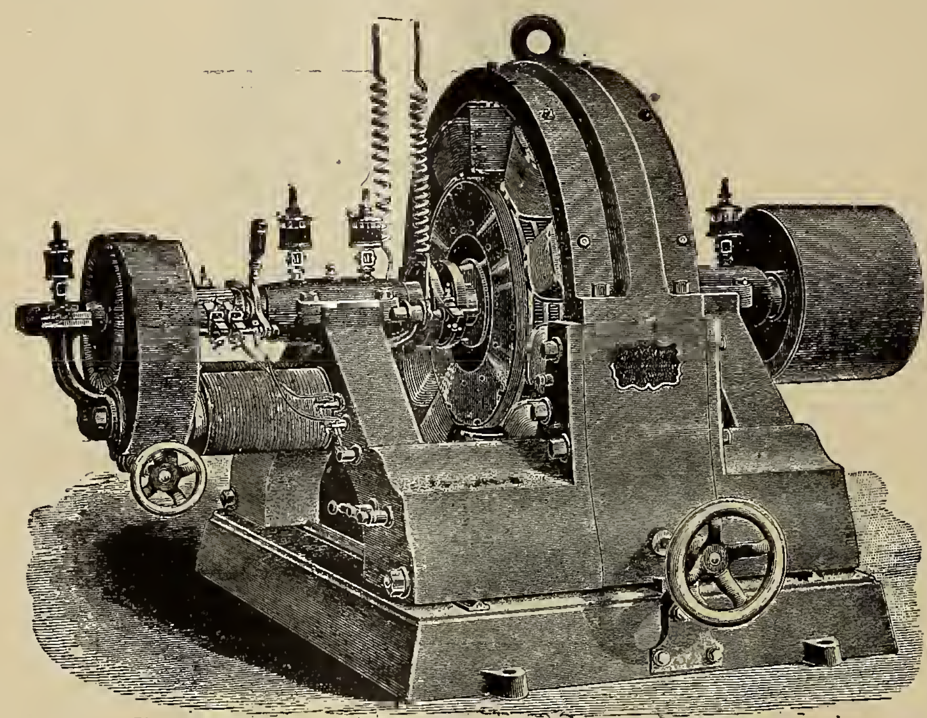
has had many years' experience in the electrical profession.

ALTERNATING CURRENTS AND ALTERNATORS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

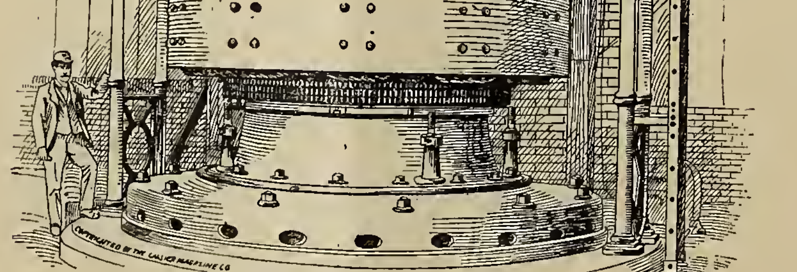
In the many applications of power to various industries none have so occupied the attention and interest of engineers as the use of alternating currents. Years ago the alternator was accepted as a simple device for the generation of reversing currents. Its comparative cheapness of construction and ease of operation have always placed it foremost as the basis of a power plant stretching over rough and rugged countries where attention and skill are of the lowest order. Jablochkoff invented his historic candles for alte nating currents and thereby drew attention to its usefulness for arc lighting. In its varied applications we meet with many unique effects. It is striking to notice the results obtained by applying it for the production of light and power and the remarkable developments that have issued from the many attempts to produce a constant and steady light, a self-starting and independent source of power. These problems have gradually reduced the field of alternating-current work to certain constricted lines.


Self-Contained Alternating Current Generator.

The labors of the past do not partake of the brilliant successes of the present. Continuous and alternating currents stand side by side as indispensable power factors, to be individually applied according to the circumstances, each with its own peculiar set of apparatus designed and perfected to perform its special work.

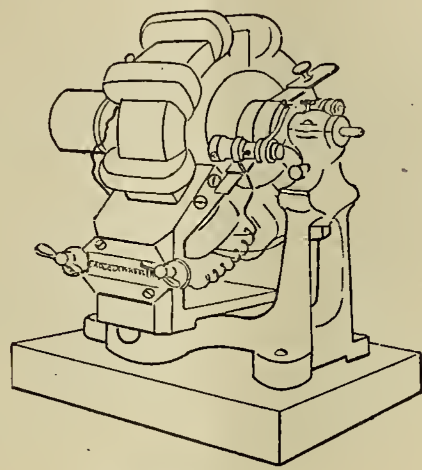
It is then necessary to accept the achievements of the past as but the beginning of a vast engineering revolution, the final outcome of which will be a new and infinitely more economical means of illumination and a cheaper source of power.

An alternating current is one in which the flow of electricity is constantly reversing. It rises to a high value like an ocean wave and recedes, growing again in the opposite direction in a similar manner. The growth of the current and its reversal in this peculiar manner is due to the arrangement of the lines of force when cut by a revolving conductor. In the alternator a series of poles are arranged around a common centre pointing inwards. As a conductor passes in front of them, each pole creates within the wire a wave of electromotive force. When the wire passes in front of the north pole the rise and fall of current is the reverse of what it would be in front of a south pole. These poles are always some multiple of two—either four, six or eight poles, etc. Therefore we have as many north as south poles. The conductor develops


Niagara Generator.

while rotating a continued succession of rapidly reversing waves of electricity, which have earned the name of alternating currents.

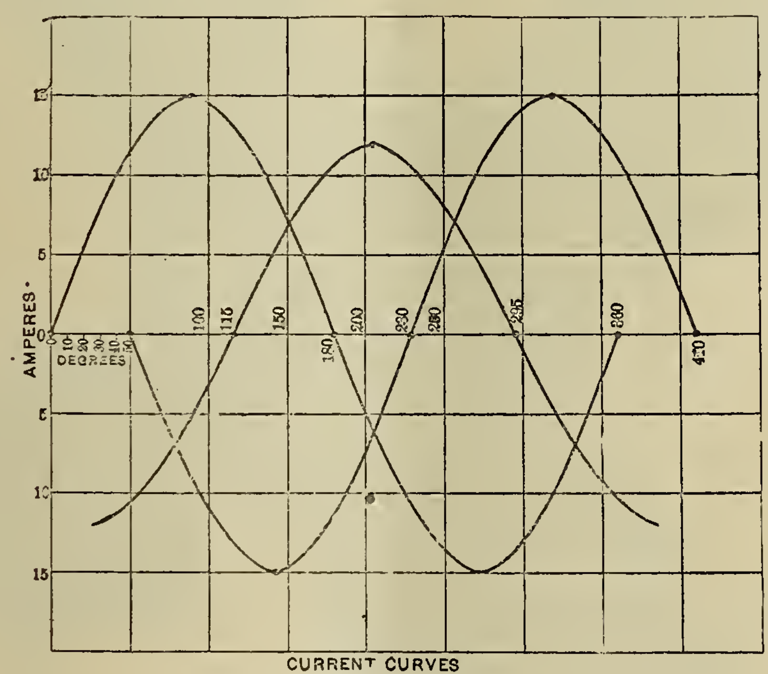
Frequency.—The rapidity with which these waves reverse back and forth is called their frequency. If a wire passes in front of a south pole the current rises and falls, but *does not reverse* in direction. If continued past a north pole, the reversal does occur; it is therefore necessary for the wire to pass before two unlike poles to provide a rise and fall and a reverse rise and fall.



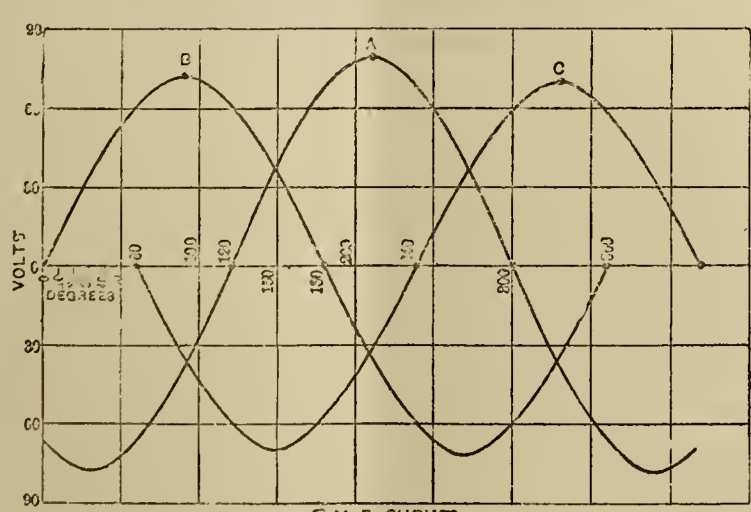
Model Alternator.

Period.—This constitutes a complete current wave. It is called a period. The number of periods are dependent upon the

Number of pairs of poles.
Speed of the dynamo.



Alternating Current Curves.



Alternating E.M.F. Curves.

To calculate the number of periods in an alternator we observe the following rule:

Number of periods = one-half of the poles $\times$ revolutions per second.

Take a dynamo having poles = 8
speed = 1,200.

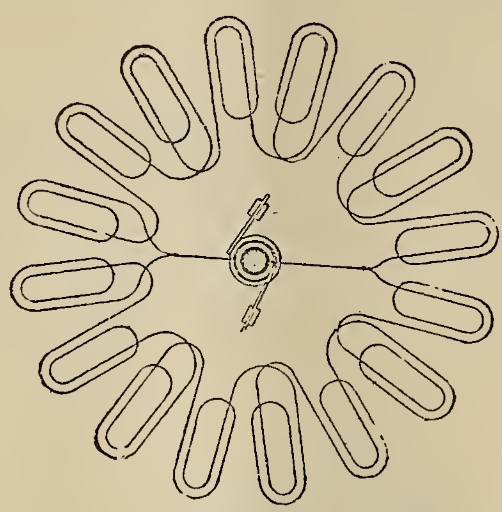
Periods = $4 \times 20 = 80$ per second.

Phase.—The rush of electromotive force through a wire is such that the entire electrical influence does not pervade it until an instant afterwards. The current does not instantly flow; a certain inertia, as it were, prevents it. The retarding influence may be either the resistance or the self-induction of the circuit.

While it is true that an electric current requires both pressure and amperes to properly deserve the name, it is possible to imagine, upon the closing of a circuit, the electromotive force at work almost at once, as though it were merely a static effect and the current requiring an exceedingly short interval afterward to follow it. In other words, pressure or potential arrives at a given point and affects it before current. The interval elapsing is called the difference of phase. There are two ways of regarding

it—as an interval of time or as an angle of difference. To our minds' eye the first is preferable, as it supplies a physical something within the grasp of all.

Impedance.—The retarding effects of resistance and



Armature Winding of Alternators.

self-induction give rise to a condition called impedance. The circuit acts as if affected by a heavy resistance; the current is restrained from flowing, and without any great consumption of energy the flow is choked. The frequency

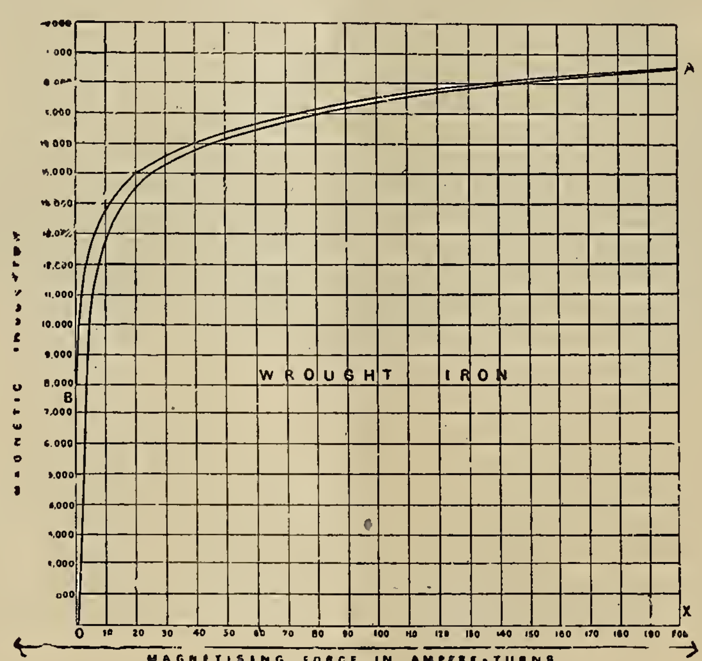
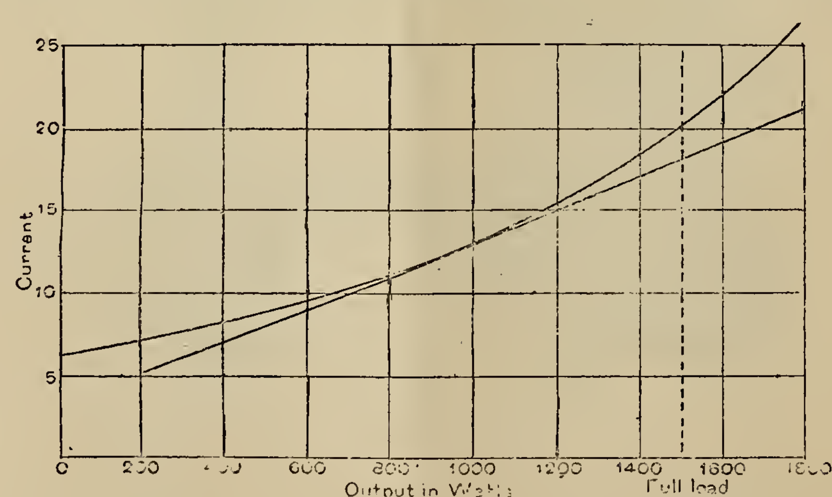


Fig. 1

also gives rise to this condition to a greater extent than self-induction.

Great rush to Europe to secure some of the contracts for the electrical railways to be built this year. Famous



electric railway builders are on the way; Frank Sprague, E. E., of Sprague Electric Co.

W. J. Clark, of General Electric Co.; John Brill, of John Brill Co., car builders, Philadelphia.

H. M. Kling, St. Louis Car Co.; Elmer P. Morris, E. E., one of the oldest electric railway builders, will start later.

FLUID AIR FOR INDUSTRIAL USES.

Liquefying air is not a new thing; it has been performed by exerting enormous pressure or by freezing air to an unusual degree, or by a combination of pressure with refrigeration. There are so many uses to which liquefied air can be put that scientists hardly know where its usefulness will end if it can be produced at a low rate of cost in commercial quantities. This a new method and machine has accomplished.

Among other advantages, air in the portable, cheap form of a liquid, as it passes back to its ordinary state, can be used for illuminating purposes by mixing its escaping gases with atmospheric air in certain definite proportions. Moreover, as a driving force in the way of detonators or explosive material to drive engines, liquid air is obviously a power that can be, under given conditions, profitably applied.

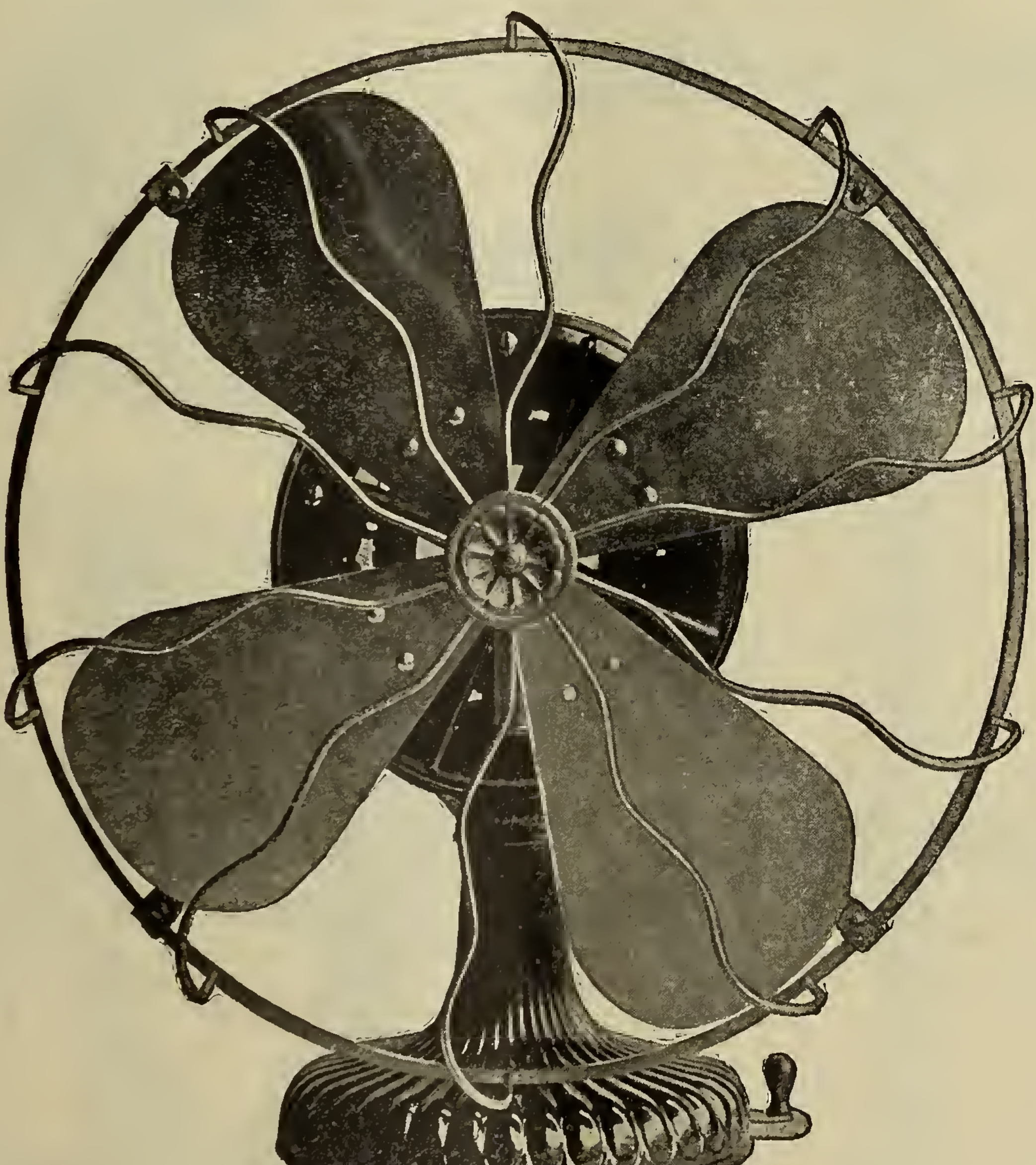
Hitherto the classic example of a method to liquefy air

and obtain oxygen has been that invented by Beatty and Cailletet in 1877. With their machine, one began with carbonic-acid gas. By means of a pump this gas was condensed in a tube, round which lay water at 10° to keep the tube cool. The carbonic-acid gas, being reduced to a very low temperature, passed from the first tube into another chamber with a tube in it, and in so doing fell to a lower temperature. Into this second tube was pumped at high pressure ethylene gas, which, in turn, fell to a low temperature, owing to the coldness of the carbonic-acid gas bathing the tube. The ethylene gas was then passed from the second tube into a third compartment and fell further in temperature in so doing. The third compartment had likewise a tube with an air pump attached. Into this third tube was pumped oxygen gas and from the ethylene gas bathing it the oxygen gas reached a temperature of 192° below zero. Finally, the oxygen was let out into a fourth compartment, in which was a fourth tube. The air pump attached to this fourth tube having filled it with condensed atmospheric air, the latter was so reduced in temperature that when it in turn was released from the tube, its cold was 273° below zero, and it appeared in the form of drops like water.

This product, which is called liquid or fluid air, has a milky appearance from the presence of some carbonic-acid gas, bubbles constantly, and from its enormous cold emits a smoke or cloud like the top of a very high mountain, and will only gradually resolve itself into air when exposed to the ordinary atmosphere.

Fluid air costs about 10 marks (say $2.25) for five cubic meters reduced. The new method is the invention of Professor Linde, of Munich. It produces the liquid for 10 pfennigs (say 2¼ cents) for five cubic meters, and it yields the product either as a gas or fluid, as one wishes. This is one of the most ingenious pieces of mechanism recently known; its chief feature is its economy of working, for it uses air to refrigerate air. After the pump has worked for a certain time, one turns a cock and the liquid air runs out at a temperature of 273° below zero.

In Professor Linde's method, an air pump of five horse-power condenses air to a pressure of 200 atmospheres; this air passes down a spiral tube and is let out in a chamber causing great cold; then it rises and passes on the outside of the spiral tube, bathing it and thus cooling the new air that has been pumped into the tube to take its place. This cooled air follows on into the chamber, expands and again lowers its temperature, then passses on up around the same spiral tube; but as its temperature has become much lower, the new air in the tube is still further refrigerated. This circulating process goes on until the new air pumped into the tube reaches the expansion chamber at a temperature of 273° below zero, when it drops into the chamber in the form of liquid. Thus the air, steadily cooled, is made to refrigerate the newly pumped air more and more, until the necessary degree of cold is attained.



Westinghouse Alternating Fan Motor.

Another idea, which may or may not be an improvement, is to have the pump and all parts of the machine kept very low in temperature.

Air in the cheap, portable form of a liquid rich in oxygen can be used for many purposes in manufactures and the trades. The discovery of a cheap method may be of importance to American manufacturers.

Charles de Kay,
Berlin, March 11, 1897. Consul-General.

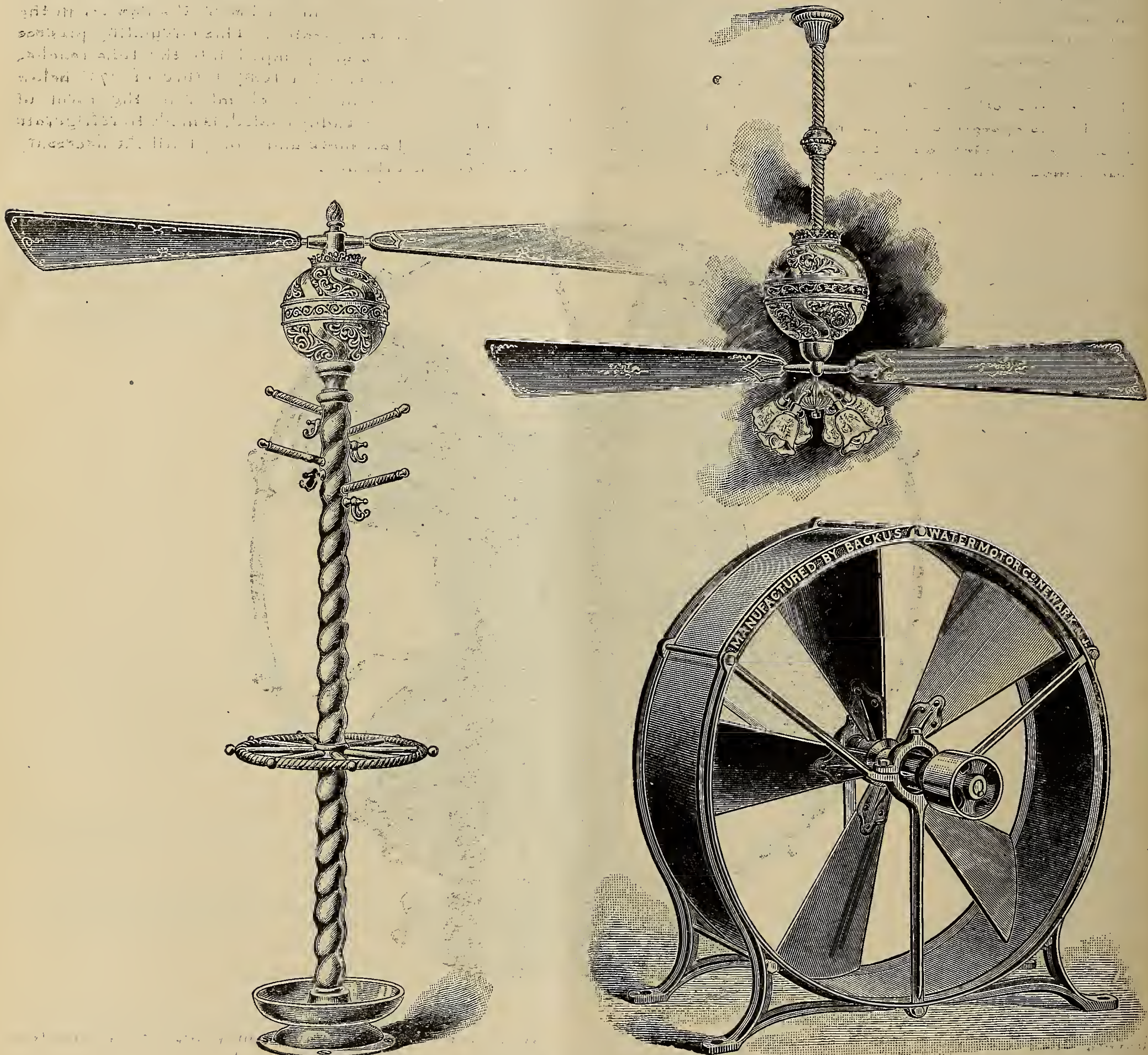
THE WESTINGHOUSE FAN MOTOR.

The illustration shows the general construction of the Westinghouse Electric Co.'s fan motor. The base forms a strong and substantial support for the motor and is provided on the side with a switch for starting, stopping and regulating the speed.

The fan runs noiselessly, the fan blades being carefully balanced and bent to the correct pitch.

Neither heating nor vibration occurs during a long run; the bearings are automatically oiled, requiring the most transient attention during the season.

Each part is carefully made and finished for the purpose of securing usefulness, durability and beauty all in one. The Westinghouse fans have gained considerable reputation for their general excellence. They are used in alternating-current circuits of commercial frequency.



Backus Ceiling and Column Exhaust Fans.

BACKUS CEILING FANS AND EXHAUST VENTILATORS.

One of the above cuts represents a combined electric light fixture and ventilating fan, which in every particular has attained a high standard of artistic beauty. There is also a button or switch at the bottom of the chandelier, or fan, which enables the party using same to run it fast or slow, or stop or start it. These fans are built in many styles and finishes, and are manufactured and sold by the Backus Water Motor Co., Newark, N. J., who publish a catalogue giving information in regard to ventilating appliances in this line.

This cut shows a column fan, also used for umbrella stand and hat and coat rack. This without question is one of the handsomest designs ever produced. This fan can also be operated by a switch, which runs it fast or slow, or stops it. Many of these fans have been sold by the Backus Water Motor Co. in the most prominent restaurants throughout the United States.

The exhaust ventilating fans used in connection with ceiling fans give without question perfect ventilation in all places where used, as the exhaust wheel removes all the hot air, smoke and smell from the building, while the ventilating ceiling fans create a pleasant current of air. These exhaust fans are used extensively for ventilating public school buildings and public buildings of all kinds. They will exhaust from 5,000 to 100,000 cubic feet of air per minute, depending upon the size of fan used. Among the large public school buildings that have recently been fitted up with the above system of ventilation by the Backus Water Motor Co. is the new No. 1 school building, Elizabethport, N. J., the new school building at Phillipsburg, N. J., and the new school building at Ridgefield, N. J.

Berea, Ohio.—The Elyria and Oberlin Electric Railway Co. has been incorporated with a capital stock of $100,000.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—MAKING DIAMONDS BY ELECTRICITY.

Utica, April 23, 1897.

Dear Sirs: Can you give me any information regarding the method of making diamonds by electricity as followed out by M. Moissan. I understand this is a specialty of his and that he has made diamonds in public that were genuine. Expecting an early answer,

I remain, yours respectfully,

L. Livgrace.

(A.)—Diamonds can be made, as they have by Moissan, without much difficulty. Crystallized carbon is the diamond pure and simple. To obtain it experimentally a mixture of metallic silver and the charcoal of sugar were fused together by the intense heat of an electric furnace. Upon cooling suddenly the tremendous pressure by contraction caused crystallization of the enclosed carbon. Moissan used iron instead of silver and obtained much finer brilliants. The metal enclosing the gem influences its shape. The diamonds are obtained by dissolving the metal in acid; they are very small and therefore hardly of any value.

(Q.)—CHEMICAL ACTION OF AN ACCUMULATOR.

New Orleans, April 15, 1897.

Electrical Age.

Dear Sirs: The general tendency of modern writers is in the direction of cramped explanations. The lucidity of those given in your valuable Inquiry Column has been deeply appreciated. I am desirous of having the theory of the accumulator explained and would be greatly indebted to you for a few words on the subject.

Yours faithfully,

C. Moran.

(A.)—Two lead plates in acidulated water are affected as follows: "The oxygen acts upon one plate and oxydizes it, causing great porosity, so that the plate has a larger surface than before. On one surface lead peroxide forms; on the other, metallic lead. When the electrolyzing current ceases, and plates are short-circuited, the hydrogen tends to deoxidize one plate; the oxygen liberated oxidizes the metallic plate until both plates are covered with a low oxide of lead and the action ceases."

CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

As the time approaches for holding our twentieth convention, unusual interest and activity is displayed by our members. The inquiries for hotel accommodations are very large, both from active and associate members and the trade in general, one company alone having reserved twenty-five rooms, another fourteen, and so on. Notwithstanding the heavy requisition for accommodations, we feel that ample provision has been made for all, as we shall practically have the resources of both the International Hotel and Cataract House at the disposal of our delegates and guests. It is well, however, to engage rooms early, to insure choice locations. This can be done by addressing the hotel direct or the secretary, Geo. F. Porter, at the headquarters of the association, 136 Liberty street, New York city.

The following named out-of-town visitors are registered at the headquarters of the National Electric Light Association, 136 Liberty street, for the week ending April 30: J. H. Bowker, Philadelphia; James Clark, Plainfield, N. J.; Wilson Kistler, Lockhaven, Pa.; J. H. Fredericks, Lock Haven, Pa.; O. W. Ruggles, Chicago, Ill.; L. A. Robinson, Pittsburgh, Pa.; A. J. Smith, Cleveland, O.; B. F. Horner, Cleveland, O.; F. J. Moore, Buffalo, N. Y.; Frank Van Dusen, Pittsburgh, Pa.; H. J. Caukins, Detroit, Mich.; Geo. W. Vallee, Philadelphia, Pa.; J. R. Wood, Philadelphia; W. E. Davis, Montreal, Canada; D. B. Martin, Baltimore, Md.; Chas. Schryver, Baltimore; C. E. Lambert, Haverstraw, N. Y.; J. W. Packard, Warren, O.; W. H. Dearborn, Philadelphia, Pa.; C. F. Munder, Springfield, Mass.; Jas. I. Ayer, Boston, Mass.; A. M. Young, Waterbury, Conn.; J. H. Reid, Pittsurgh, Pa.

REVIEW.

A volume entitled "Magnetic Fields of Force," by H. Ebert, has been published by Longmans, Green & Co.

The detailed information it contains will prove to be not only instructive to the technical student but deeply interesting to the general reader.

The development of the subject of magnetism as followed out by Mr. Ebert indicates a thorough acquaintance with the most modern opinions. The explanation and illustration of the present theories cannot be excelled for lucidity and impressiveness. A careful reader of this volume will find himself in possession of facts relative to the subject of magnetism that will undoubtedly influence any other opinions he may have previously held.

The book is divided into two parts, section I treating of the phenomena of magnetism, the other, section II, of the phenomena of the galvanic current and of electromagnetism. The dynamical theories of fields of force in section I and mutual action of currents and magnets in section II are worth reading in the most careful manner. This book is food to the practical mind and fascinating to the more theoretically inclined. It strikes a happy medium and should meet with success.

WARREN ELECTRIC CO., Greenwich and Desbrosses streets, City, were just shipping a 15-H.P. Edison motor, one mile of heavy insulated conductor and an equipment for running Tilyou's Mechanical Race Track, on the Bowery at Coney Island. The horses are life size, running on tracks five in a row. Will be mounted by participators; the horses driven by the aid of a motor, current being taken from Tilyou's isolated plant, nearly a mile away.

G. HUMBROCK, successor to A. C. Jahl, 39 Cortlandt street, N. Y., manufacturers' agent for electric light, power and railway supplies. He is prepared to fill orders with promptness. Mr. Humbrock is ably provided with funds to supply a complete equipment for either a light or power station.

THE WARD ELECTRIC SUPPLY AND CONSTRUCTION CO., 39 Ann street, are having a rush with their arc lamps. They are going so fast it keeps them hustling. A few are still left at low prices, besides the arc lamp resistances they make a specialty of. Construction work is on the increase and fan motors are booming. A big contract has just been closed for 500 lights, interior conduit system.

NEW TELEPHONE COMPANIES.

Fort Smith, Ark.—The Pan Telephone Co. has been incorporated by L. E. Ingalls, W. H. H. Clayton and J. Brizzolara. Capital stock, $15,000.

Cambridge Springs, Fla.—The Cambridge Springs Electric Telegraph and Telephone Co. has been incorporated, with a capital stock of $10,000.

NEW CORPORATIONS.

Saco, Me.—The Grafton Construction Co. has been organized with Nathan Pike, president; Frank A. Dearborn, treasurer; for the purpose of constructing and operating electric light and power plants of every description. Capital stock, $10,000.

Bellvue, Pa.—The Ohio Valley Electric Co. has increased its debt from nothing to $50,000, and its capital stock from $10,000 to $50,000.

Pittsburgh, Pa.—Beechwood Street Railway Co. has been incorporated with a capital stock of $15,000.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued January 5, 1897.

574,370. Manufacture of Incandescent Electric Lamps. Thomas B. Atterbury, Pittsburgh, Pa. Filed December, 18, 1894.

574,377. Electric Railway Trolley. Edward M. Bentley, New York, N. Y. Filed July 28, 1896.

574,388. Electric Propulsion of Vehicles. William A. Butler, New York, N. Y. Filed March 19, 1895.

574,417. Secondary Battery and Process of Forming Same. George W. Harris and Richard J. Holland, New York, N. Y. Filed January 30, 1896.

574,430. Subway Conduit. Wilbur H. Johnston, St. Louis, Mo. Filed August 15, 1896.

574,536. Electrically Heated Sad-iron. William S. Hadaway, Jr., New York, N. Y. Filed April 7, 1896.

574,537. Automatically Contolled Electric Oven. William S. Hadaway, Jr., New York, N. Y. Filed May 4, 1896.

574,565. Electric Meter for Alternating Currents. Granville F. Packard, Fort Wayne, Ind. Filed October 26, 1896.

574,579. Circuit for Annunciators of Telephone Lines. Charles E. Scribner, Chicago, and Frank R. McBerty, Downer's Grove, Ill. Filed May 14, 1896.

574,632. Electric Railway. William M. Schlesinger, Philadelphia, Pa. Filed October 12, 1887.

574,642. Telephone Switchboard. Henry J. Swarts, Knoxville, Tenn. Filed December 24, 1895.

574,654. Telephone Receiver. Russell S. Barnum, Chicago, Ill. Filed April 3, 1896.

574,669. Electric Clock. Charles M. Crook, Chicago, Ill. Filed December 12, 1895.

574,707. Automatic Telephone Exchange System. Lawrence G. Bowman, New York, N. Y. Filed July 18, 1896.

574,739. Electrical Measuring and Indicating Apparatus. John F. Kelly, Pittsfield, Mass. Filed June 16, 1896.

574,828. Insulator. Benjamin D. B. Smock, Wickatunk, N. J. Filed March 10, 1896.

574,843. Method of Electrolytically Uniting Glass Tiles into a Body. William H. Winslow, Chicago, Ill. Filed November 2, 1896.

574,846. Fluid Pressure Regulator. Edgar H. Freeman, Rochester, N. Y. Filed July 16, 1894.

574,856. Electric Alarm Device. George V. Trott, Chicago, Ill. Filed April 10, 1896.

574,118. Electric Arc Lamp. Henry A. Seymour, Washington, D. C. Filed July 11, 1896.

574,119. Electric Arc Lamp. Henry A. Seymour, Washington, D. C. Filed July 18, 1896.

574,120. Electric Car Brake. Elmer A. Sperry, Cleveland, Ohio. Filed June 26, 1896.

574,123. Electric Arc Lamp. Elihu Thomson, Swampscott, Mass. Filed August 21, 1896.

574,160. Means for Reheating Exhaust Steam. Oscar D. McClellan and Wilkinson T. Girling, Philadelphia, Pa. Filed July 1, 1896.

574,171. Electric Railway. John A. Roche, Chicago, Ill. Filed April 13, 1895.

574,203. Electric Branding Stamp. James M. Kirker, McGonigale Miller and James A. Williams, Louisville, Ky. Filed March 16, 1896.

574,205. Race Starting Machine. William Maxwell. St. Louis, Mo. Filed June 29, 1896.

574,215. Electro-motor Magnet. Charles Partington, Newport, Ky. Filed March 6, 1896.

574,217. Voltage Regulator for Dynamos. Thomas M. Pusey, Kennet, Pa. Filed May 22, 1896.

574,221. Telephone Exchange System. Charles E. Scribner, Chicago, Ill. Filed June 6, 1894.

574,222. Selective Signal System. Charles E. Scribner, Chicago, Ill. Filed January 8, 1895.

574,223. Selective Signal. Charles E. Scribner, Chicago, Ill. Filed August 23. 1895.

574,224. Spring-jack for Telephone Switchboards. Filed July 5, 1894; renewed July 13, 1896.

574,225. Signalling Apparatus for Telephone Lines. Charles E. Scribner, Chicago, and Frank R. McBerty. Downer's Grove, Ill. Filed August 17, 1895.

574,231. Current Controller or Rheostat. Ernest E. Werner, Dallas, Tex. Filed June 22, 1896.

574,245. Telephone Switch Box. Wallace A. Houts, Parker, S. D, and Lars G. Nilson, Sioux City, Iowa. Filed August 25, 1896.

574,255. Telephone Exchange Apparatus. Frank R. McBerty, Downer's Grove, Ill. Filed May 25, 1896.

574,278. Motor-generator. Charles E. Scribner, Chicago, Ill. Filed June 1, 1889.

574,279. Signaling Circuit for Telephone Trunk Lines. Charles E. Scribner, Chicago, Ill. Filed May 14, 1896.

The Electrical Age.

VOL. XIX., No. 20. NEW YORK, MAY 15, 1897. WHOLE No. 522

Overhead Trolley System, Cape Town, Africa. (Courtesy of Inventive Age.)

THE TROLLEY IN SOUTH AFRICA.

We have heard of the Sultan of Turkey riding around in an electric tricycle and of Sprague motors being installed in Jerusalem, but the latest information of interest is that regarding a trolley road in Cape Town, South Africa. The illustration gives one a general idea of the scene there ; the native in his light summer rig, a few Caucasian faces and the most modern of street conveyances in the midst of the crowd. The cut is one used in Cassier's Magazine in an article by Nelson W. Perry entitled "Electric Traction in City Streets."

The proportions of this thriving city are not large, yet its inhabitants are industrious, ingenious and of a progressive nature. In fact, the last fifty years has instituted a change in manners of life and home which speaks well for the future of Cape Town.

The rough element has been extinguished and English customs prevail almost exclusively. The wilderness has disappeared with its dark warriors and darker scenes. Civilization has set its foot firmly in this section of Africa and its influence has affected even the original inhabitants for the better, giving them higher ambitions and superior culture.

BATTERY SYSTEM FOR ELECTRIC LIGHTING.

One of the latest inventions to come into general use is an ingenious automatic battery system for electric lighting. The apparatus will be put up in cabinet form designed for apartments, stores, private residences, seagoing vessels and pleasure craft.

As indicated by the name, this battery is entirely automatic, requiring no attention whatever except change of electrodes every six months. Arrangements for making the change are extremely simple and the ordinary servant can do so with perfect ease and without any possibility of getting it out of order.

For the first time a satisfactory system has been devised in the above apparatus that will meet the wants of the railways in throwing switches, sounding signals and lighting semaphores.

The inventor has had a large experience, having manufactured batteries for the Treasury Department of the United States as well as for fire alarms, telegrhaphs, hotels, etc. He has now succeeded in perfecting what he felt some seven years ago he would do, and it is believed that all people who keep familiar with electrical subjects throughout the world will remember one of his remarkable achievements when, about seven years ago, there came a well authenticated report from a near-by city that a circuit of bluestone batteries had been thrown into use instantaneously upon the completion of their setting up and with the use of water only.

His past success and long research in this line lend much weight to the inventor's opinion, that with the use of this battery the telegraph service will be greatly improved, as well as rapid and long distance telephoning.

A strong financial company, including among its directors the leading bankers of Wall street, is about to be organized to put the discovery of Mr. Archer on the market simultaneously in the United States and all European countries.

Complete details and diagrams will appear later in the columns of the Electrical Age.

MODERN OVERHEAD CONSTRUCTION.

At the expiration of twenty-four years the construction will be renewed for the third time at a cost of $728 00, and to this will be added the interest for six years at five per cent. per annum, $218 40, making the third investment at the end of thirty years cost $346 40, a grand total for wood pole construction of $4,149 60.

The difference between total costs of steel and wood pole construction for a period of thirty years would be $920 40 per mile, which would be more than a liberal allowance for changing span wires and other work ; but, assuming it would take this amount, we would stand even at the end of thirty years and still have six years more paid for on wood pole construction. If steel span poles are used, would recommend for the average span of forty feet a pole weighing about 700 pounds made in two parts; the lower section to be constructed of 6-in. extra heavy, and the upper section of 5-in. standard steel pipe swagged at the joint for a distance of eighteen inches; such a pole to be twenty-eight feet long, eighteen feet for the lower and ten feet for the upper section, and provided with a cast iron and wood pole top, for the attachment of the span wires. Such poles should be provided with a wood filling to fit the bottom of the lower half, to prevent it from sinking, and should be set six feet in the ground with a rake of ten inches from the perpendicular to allow for being straightened when under strain. The average size of hole to be dug would be twenty inches in diameter with a depth of little over six feet, requiring (after the pole is inserted) a mixture of about one-half cubic yard of concrete composed of one part of Portland cement, two parts of sharp sand and four parts of broken rock. The cement should be given at least three days, in order to set firmly, before attaching the span wires. Whenever it is practical to allow poles to bear against the curbing this should be taken advantage of, as it affords an efficient stay to assist the pole in resisting the strain. Should it not be possible to secure use of the curb (or paving) a good-sized rock having a bearing surface of about one square foot would assist very much and keep the pressure from cracking the cement.

If wood poles are used, where it is necessary to make neat appearing and substantial construction I would recommend, for the average span of forty feet, a long leaf yellow pine pole dressed and chanfered, thirty feet long, sawed square, eleven inches by eleven inches at the base and seven inches by seven inches at the point, free from sap, rot or knots, and corners evenly chanfered one and one-half inches, beginning at a point fourteen feet from the base and terminating in an octagonal form, and roofed evenly for a space of three inches.

In setting wood poles where concrete is not used (and I do not consider it necessary), a great deal depends upon the soil encountered. Whereas it is necessary to use very little prepared material for filling in some localities, it will take a quantity in others, so I will mention what would be required in a soil of medium clay and character which would probably meet the average condition. Poles should be set six feet in the ground with a rake of twelve inches from the perpendicular, to allow for being straightened when under strain, and the hole should be dug to a vertical depth of six feet (or more if necessary to allow the pole to stand a given height above the track) in the ground, and should be about two feet square at the top and not less than eighteen inches at the bottom. Where it is practical to allow poles to bear against the curbing or paving this should be taken advantage of, and it will not be necessary to use other material near the surface, as in iron pole construction, but it will be necessary to place a substantial bearing at the heel, to prevent the pole from pressing through the earth. For this purpose a small quantity of coarse, broken stone or brickbats will answer every purpose, and where this is not easily obtainable and the earth is soft a piece of plank twelve inches wide and three inches thick, four feet long, sharpened and driven in the earth to a depth of about two feet at the back and base of the pole, will give good results.

Whenever it is necessary to erect poles in the absence of substantial material at the surface, such as paving or curbing, I would recommend that the base of the pole be well rammed with broken rock for a distance of eighteen inches, taking pains that the greater quantity is placed at the back, where the pressure is greatest, and leaving a small quantity in front, where no pressure takes place. The space to within twenty inches of the top may be filled with earth taken from the hole and well rammed. To prevent the pole from yielding at the surface a breast-plank of oak or cyprus timber, 3 x 12 x 72 inches, should be placed and spiked in front and at right angles to the pole about eight inches under the surface of the ground, which would make a suitable bearing surface and resist the span wire strain. About twenty inches from the top of the hole and in front of the breast-plank should be filled and well rammed with the same material as is used at the base of the pole. The necessary quantity of broken rock required would be about two-tenths of a cubic yard to the pole.

Poles of wood or steel, which may be used for holding strains at curves, should necessarily be heavier than those used for straight line construction, and should also be set at greater depth in the ground. Steel poles of proper dimensions for curve construction would be made in two joints and constructed on the same principle as the straight line pole, excepting with heavier dimensions of pipe. A steel pole for curve construction should be twenty-nine feet long, made of 6-in. and 7-in. extra heavy pipe, the larger section to be nineteen feet long and the smaller section to be ten feet long, and made to weigh 1,050 pounds. Such poles should be set seven feet in the ground, and raked ten inches from the perpendicular in a direction radiating from central point of curve where strain is required. The filling necessary would be the same as specified for straight line iron pole construction.

(To be Continued.)

TRANSFORMERS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

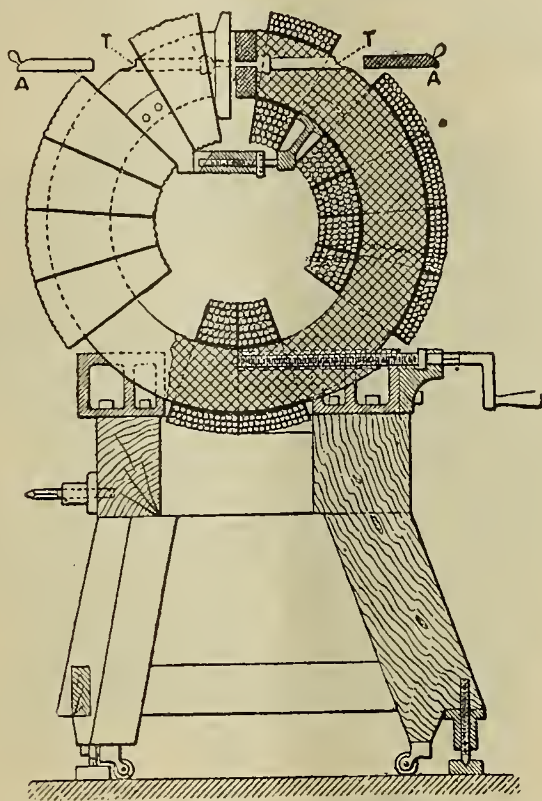
BY NEWTON HARRISON, E. E.

(1.) The interesting methods by which alternating current apparatus is designed and constructed, and the peculiar effects manifesting themselves, have given rise to a closer study of the subject in all its varied details. Not only have some of the greater difficulties been overcome, but its introduction beside and as an active and equal competitor of continuous currents in a commercial and practical sense is plainly evident.

Alternating Current Motors.—For many years the sluggish progress of alternating-current practice could be easily traced to the lack of a motor which could compete in the open market with the others. It had been deemed impossible to construct one of this kind. To obtain power in the form of mechanical energy from an alternating-current circuit necessitated the use of another alternator of the same frequency. This motor, to be, was rotated up to its proper speed by some additional device, and then the current applied.

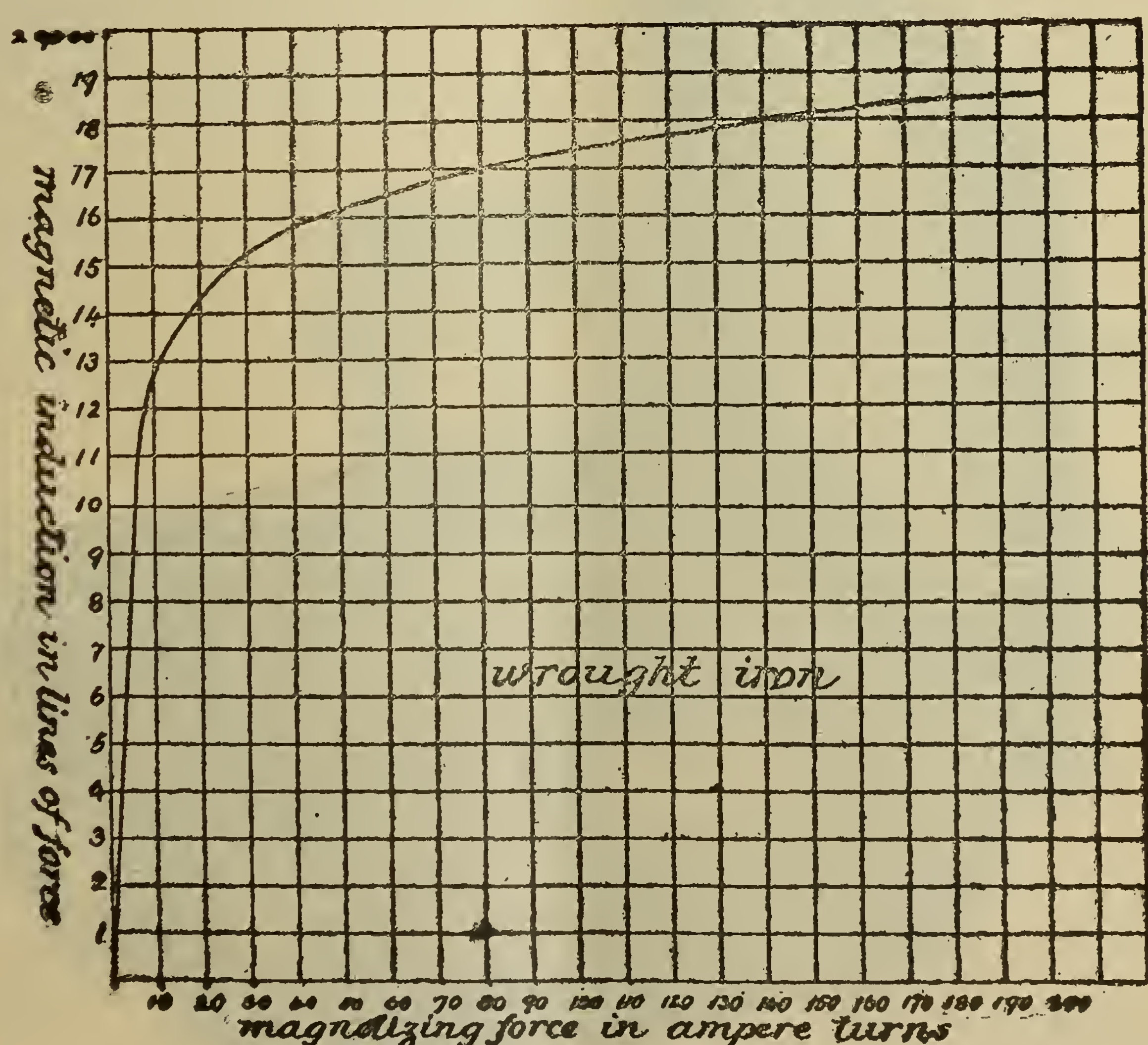
Synchronism.—With the frequency or periods of both generator and motor equal, the machines are said to be in "step," or in synchronism with each other. The difficulty now arises, however ; with a dropping in speed of the motor, this condition of electrical harmony, as it were, ceases to exist. Both machines fall out of synchronism, and the motor, after a short interval, comes to rest. This

difficulty was for a long time ineradicable. It was impossible to start an alternating-current motor from a condition of quietude, and likewise impossible to hold it in synchronism with considerable changes of load. Any continuous-current motor, at least, possessed this qualification of being *self-starting ;* a great handicap, therefore,



Device for Froducing Intense Magnetic Fields.

stood in the way of making an even test of both systems. A difficulty of this character deprived the exponents of alternating-current machinery of a most valuable feature. Transmission of power was not very practical, although



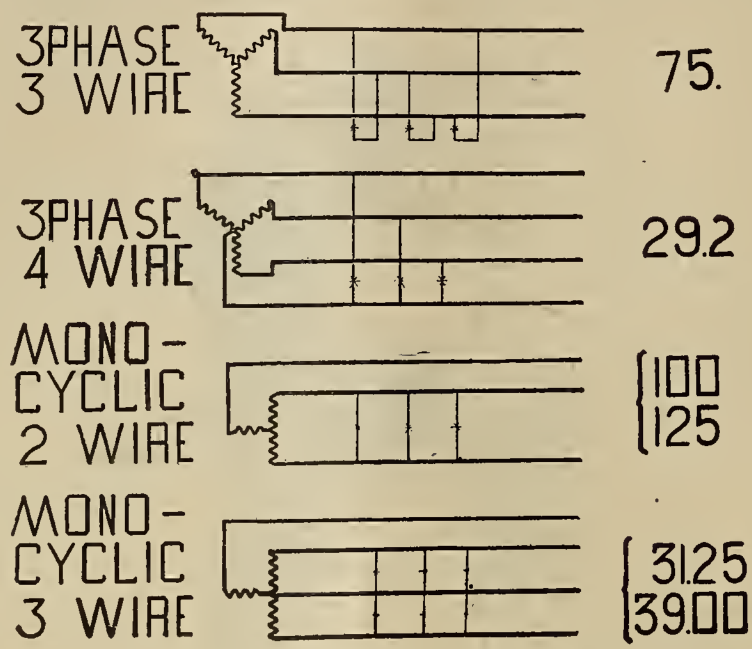
Curve of the Magetization in Wrought Iron.

the mere laying of a long line was and has been an easy achievement.

Rotary Field Motors.—It was discovered by our famous inventor, Nikola Tesla, that if by any possibility a magnetic field was caused to travel around an iron circuit, or in any way allowed to affect an armature core wound or bare—if the metal mass in the centre is free to rotate—this circulating field will drag it around to a high rate of speed. A rotary field is produced by means of polyphasal currents—peculiar impulses, identical with an ordinary alternating current, but consisting of not one, but two or three successive impulses forward and the reverse backward.

Polyphasal Currents differ in no respect from an ordinary alternating current. A single impulse rising and falling in a wire can, in imagination, be succeeded by another before the first has begun to decrease. Likewise, the second might be followed by a third impulse, which has

the same difference of phase between it and the second as exists between the second and the first. This system can be developed to any extent. To create a rotary field, for instance, with a current of these impulses or waves, a ring of iron wound with three coils each one-third around, and receiving successively a wave of electromotive force, would naturally produce a magnetic field of this description. Whether iron or copper be placed in the centre, the field will drag it around. A *polyphasal* current means a current of many phases; the word *poly* meaning many. The additional fact that when an armature is gripped at points all around its periphery it is better able to develop torque, has made this innovation decidedly practical.



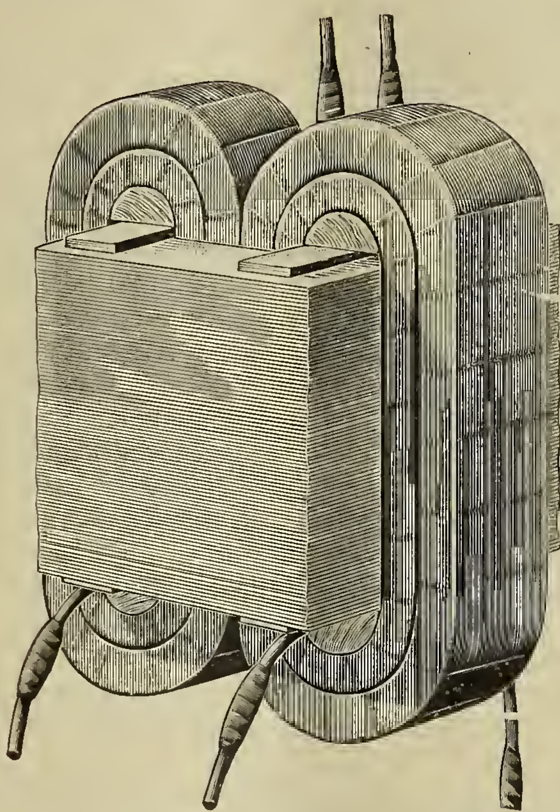
Systems of Alternating Current Distribution.

A Sine Wave is the name given to a wave of electromotive force of current proceeding from an alternator. It was discovered by Joubert that the mathematical curve called the sine curve and the diagrammatic representation

Weston Meter for Alternating Pressures.

of a rise and fall in electromotive force differed so slightly from each other that the latter deserved the same name.

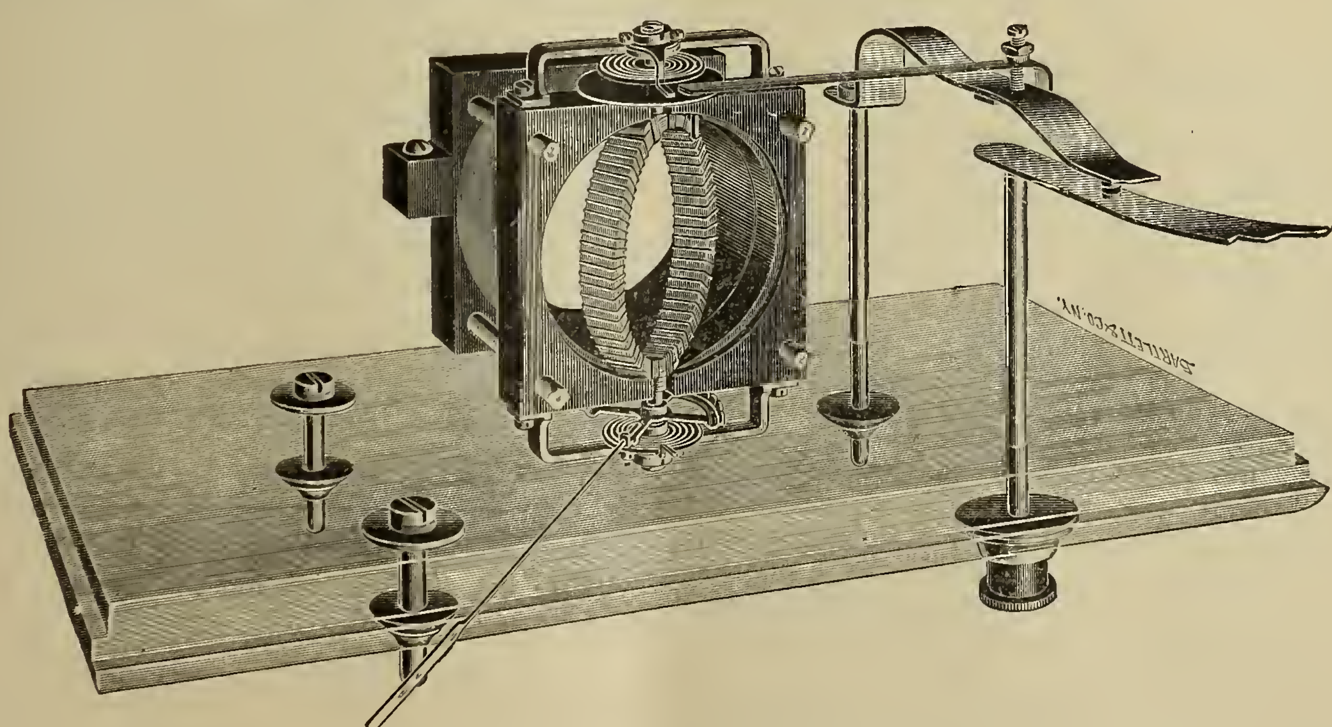
True Value of the Current.—An alternating current has no fixed or uniform value. It rises and falls like an ocean swell, beginning, growing rapidly to a hilly prominence, and subsiding again to nothing. There is no definite value to be given to the flow of an alternating current



The Scheeffer Transformer. Diamond Electric Co.

that is other than approximate. At each instant of its growth and decrease it has a decided value, but this constantly changes, varying from nothing to a maximum; that is, its highest value. We are forced, therefore, to judge by approximation of its real strength; in fact, to measure it by two methods.

Mean Current.—One of these methods is that of taking the value of the current at successive instants of its rise



Mechanism of Alternating Current Voltmeter.

and fall and forming an average, calling this the mean current. If the current rose and fell and the seven tests showed the values of

0
2
4
6
4
2
0

the average would be $\overline{18}$ $\frac{18}{7} = 2\frac{4}{7}$ amperes.

This value, 2.57 amperes, is called the *mean current.*

Square Root of the Mean Square.—Another method is that of taking the same measurements, squaring each result, taking the average of the squares, and then taking its square root. The process with the same figures would be that of squaring

$0 = 0$
$2 = 4$
$4 = 16$
$6 = 36$
$4 = 16$
$2 = 4$
$0 = 0$

Taking the average square, 76

$$\frac{76}{7} = 10\frac{6}{7},$$

extracting the square root gives us 3.29 amperes. In practice this value is accepted as the nearest approximation, and is used in ordinary calculations.

(2.) The different values of the current does not prevent the instrument maker from constructing meters which will measure the "square root of the mean square." The pulsations of an arc light current practically consist of a series of waves always passing onward in one direction

but virtually similar in general appearance to an alternating wave. The rapidity with which a series of alternations pass back and forth is productive of several strange effects. A piece of metal of any description when thus influenced becomes warm and possibly very hot. When a coil of wire containing a core of iron is magnetized and demagnetized by an alternating current a peculiar hum is heard. The more rapidly the current reverses the louder the hum, until its resonant sound is like a low musical tone. The iron within the core will become very warm and have a curious effect upon a piece of metal placed near it, repelling it with considerable force and likewise exciting heat in it. The explanation given of the effect produced in iron is twofold.

First—It is observed that the magnetization consumes power. A piece of iron magnetized by a current flowing in one direction will consume more power to bring it back again to a neutral condition than it did in becoming magnetic. This consumption of power is called *hysteresis*, and is due to a certain molecular condition causing a rigidity of the particles and therefore depending upon the quality of the iron for its extent. A piece of steel would consume more power than soft wrought-iron while undergoing the process of magnetization and demagnetization: a well annealed piece of iron, less than the ordinary wrought-iron not treated in this manner. Mr. Kapp has given figures on the amount of energy consumed in a mass of iron by hysteresis. The reversals occurred 100 times per second, giving 200 changes. These results are true for the iron of a transformer.

(At 100 complete periods a second.)

Lines of force in iron.	Volts per ton of iron.	Horse-power wasted in heat per ton of iron.
2,000	650	.87
3,000	1,100	1.48
4,000	1,650	2.21
5,000	2,250	3,02
6,000	2,900	3.89
7,000	3,750	5.03
8,000	4,450	5.97
9,000	5,500	7.43
10,000	6,650	8.90

This phenomenon called hysteresis will have such an effect upon the iron that only after the magnetizing force has been partially removed the influence steals over the iron and develops lines of force. A difference of phase, therefore, exists between the magnetizing force and the lines of force produced, or what might be called the resultant magnetization. The other effect acting upon the iron is much simpler in its nature. It is due to *eddy* currents, small whirling currents induced in the iron by the fact that lines of force are cutting it, passing and repassing so rapidly that an electromotive force is set up and necessarily a current. To avoid these eddy currents the iron is subdivided into thin sheets or used in the form of wire. This treatment will not in the least reduce the hysteresis, as that is entirely due to the molecular condition of the iron, but will reduce the eddies by insulating the parts of the metal from each other. The currents then produced have so short a circuit to flow in that their volume is very slight and the heat very little. The hysteresis in iron depends upon the extent to which it is magnetized and naturally upon the rapidity with which these changes occur. These, in addition to the fact that it likewise depends upon the quality of the iron, enable us to reduce or increase it at will or hold it well in check. The importance of understanding these effects and their causes is clearly seen in the design of a transformer. A *transformer* is a device by means of which a given electromotive force can be increased or decreased.

There are two classes of transformers :

Step-up transformers,

Step-down transformers.

In city circuits the step-down transformer is generally used. A pressure varying from 1,000 to 2,000 volts is applied to it and reduced down for purposes of light or power to 50 or 100 volts as required. The transformer consists of a frame of iron upon which are placed two coils of wire. The coils link in with a complete magnetic circuit formed by the iron. The iron is generally used in thin plates and the two coils thoroughly insulated from it and each other are linked by it. Thus, there may be a circle of iron and a coil on each side of it at the opposite extremities of a diameter. The resistance and turns of each coil are duly proportioned to receive and give individually the proper current and pressure.

The iron being continually subject to violent reversals, must create the least possible heat and absorb little or no power. To do this both the hysteresis and eddy currents must be kept down to a certain low but definite value.

(3.) To design a transformer to meet the demands of practice, the conditions of practice must be considered in full. An induction coil and a transformer merely differ in detail; they are identical in principle.

Construction.—A transformer consists of a closed magnetic circuit and two coils of wire. The coil connecting to the source of current is called the *primary*, and that in circuit with the line or lights the *secondary*. In commercial lighting the primary is fed with a current of about 2,000 volts; the secondary delivers the same amount of energy minus loss, at 50 volts. It is natural that the transformer, like any other piece of apparatus, should be of a size consistent with the service it is to perform. Transformers are therefore rated as 5-light, 10-light, 50-light, 100-light, etc. The weight of iron and copper also increases with the number of lights supplied.

Design.—The iron and copper used in definite proportions will give the best effect, provided they are of the quality used by large companies. That is, the iron must be of the softest kind and the copper pure. The size of a transformer then depends upon the number of lines of force it contains. In the case at hand, if the number of lines of force per square inch be too high, hysteresis will heat and endanger the construction. It is necessary that the magnetic induction be kept very low; from 8,000 to 12,000 lines of force per square inch, or higher if the designer sees fit. The previous table will give an idea of the losses entailed with higher induction.

Having determined to keep the induction low, the ampere turns required and the weight of copper come into consideration. The rule for calculating the turns is simple, the primary and secondary being individually treated. If the primary receives 2,000 volts and the secondary reduces it down to 50 volts, the ratio between them is 2,000 : 50, or 40 : 1.

This ratio of 40 : 1 represents the proportion existing between the turns on primary and secondary.

Each turn on the secondary is counterbalanced by 40 on the primary. The rule for keeping this fact in mind is

$$\frac{\text{E. M. F. Secondary}}{\text{E. M. F. Primary}} = \frac{\text{Turns Secondary.}}{\text{Turns Primary.}}$$

The method of calculating the turns on the primary is as follows :

$$\text{E. M. F.} = \frac{\text{Turns} \times \text{Lines force} \times \text{frequency.}}{100{,}000{,}000}$$

The arbitrarily adopted factors are the turns and lines of force. The frequency is from 100 to 150 at the utmost. To illustrate the above, take a case as follows : A dynamo producing 2,000 volts is to be connected to a transformer which will reduce it down to 50 volts ; we now have

$$2{,}000 = \frac{\text{Turns} \times \text{Lines force} \times \text{frequency.}}{100{,}000{,}000.}$$

Adopting a frequency of 100 per second, the above becomes

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CONTENTS.

A TRIBUTE TO AMERICAN MANUFACTURERS.

The great manufacturing countries of this world no longer regard England as the head and centre of the most important or best developed industries.

She does not assume that position herself at present without considerable hesitation and at times, as evinced by the following note, frankly confesses her inability to compete with American methods when tied down to a limited time of delivery:

London, April 30.—In the House of Commons today the president of the Board of Trade, C. T. Ritchie, replying to Sir Charles Howard Vincent, said the Government was not prepared to compel companies applying for new railway charters to buy their equipment in the United Kingdom.

In the case of the Waterloo City Railway, Mr. Ritchie added, twenty-two cars had been ordered in America, because out of the *seven English firms* tendering for the work not one of them was able to deliver the stock in the time required by the railroad company.

There need be no cock-crowing vanity on the part of ourselves because this is true, but rather an outburst of redoubled energy for the purpose of demonstrating our ability to reign supreme in other circles possibly, and the future alone can tell whether we will in the great majority of them.

Our relations with England have enabled us to cut loose from the slow hum-drnm and old-fashioned methods of manufacturing. England produces and ships much that we have as yet not competed with her in. But the next fifty years will show us off to advantage in the wide-spreading fields of commerce.

IMPORTANT PATENT DECISION.

The recent decision in favor of Berliner sweeps from the field the greater part of the opposition previously existing against the Bell Telephone Company.

The decision in this case brings to light what might be called a humorous state of affairs.

The Bell Telephone Company had intimated its intention of going into the telegraph business, thus engaging in two associated and highly lucrative employments. The Western Union Company immediately proclaimed its intention of retaliating by entering the field of telephony. At the present time it will be impossible for them to continue, as the Bell Telephone Company would quickly obtain an injunction and restrain them from carrying out their plan; consequently the Western Union will have to retire from the field in a hurry and the Bell Telephone Company can still advance into the enemy's country without fear or hesitation.

The Bell patent, applied for in 1877 and granted thirteen years later, gives this corporation control of all battery transmitters. It practically closes the field to outsiders and encourages the formation and growth of what may prove to be one of the greatest concerns of the closing century.

Well; the row is over, and the sooner those engaged in infringing pack up their traps and get out the better, unless they can stand a siege. It is unfortunate that this stupendous control is exercised by one organization, but if their monopoly is sanctified by the highest judicial circles, what can the rest do? Many in the trade think the battle just begun. Time will tell.

The following out-of-town visitors are registered at the headquarters of the National Electric Light Association for the week ending this day (May 7, 1897):

M. E. Baird, Windsor, Conn.
W. E. Sharps, Philadelphia, Pa.
J. L. Fannon, "
H. E. Peters, "
H. B. Custer, "
F. O. Briggs, Trenton, N. J.
David Bloch, City of Mexico.
L. B. Billswell, Pittsburgh, Pa.
P. W. Darlington, Philadelphia.
H. T. Mooney, Poughkeepsie, N. Y.

A great many inquiries are being received at this office regarding exhibits at the coming Niagara Convention. For the benefit of those desiring to make an exhibit, we will state that no exhibition will be held under the auspices of the association, but from the tenor of our correspondence and personal interviews, we learn that many exhibitions will be made by our associate members in the parlors and rooms of the hotel.

Geo. F. Porter, Secretary.

We would add that provision is being made by the International Hotel and Cataract House to set up all the exhibits that come along.—Electrical Age.

Electric Tramways in New York.—The Metropolitan Traction Company has confirmed the announcement of its decision to adopt electricity on several of its lines. Out of 165 miles of road 43 will be operated electrically, and the method of traction will be that of the underground conduit. Mr. J. D. Crimmins, speaking for the company, states that the cost of running a car for one mile, including everything but the fixed charges on the investment, is, with electricity, nine to nine and one-half cents; with compressed air, 12 to 14 cents; and with the cable, about 18 cents.—London Invention.

Augusta, Ga.—An electric light and power plant will be established.

$$2{,}000 = \frac{\text{Turns} \times \text{Lines force} \times 100.}{100{,}000{,}000}$$

Adopting 1,000,000 lines of force, we have

$$2{,}000 = \frac{\text{Turns} \times 1{,}000{,}000 \times 100.}{100{,}000.000.}$$

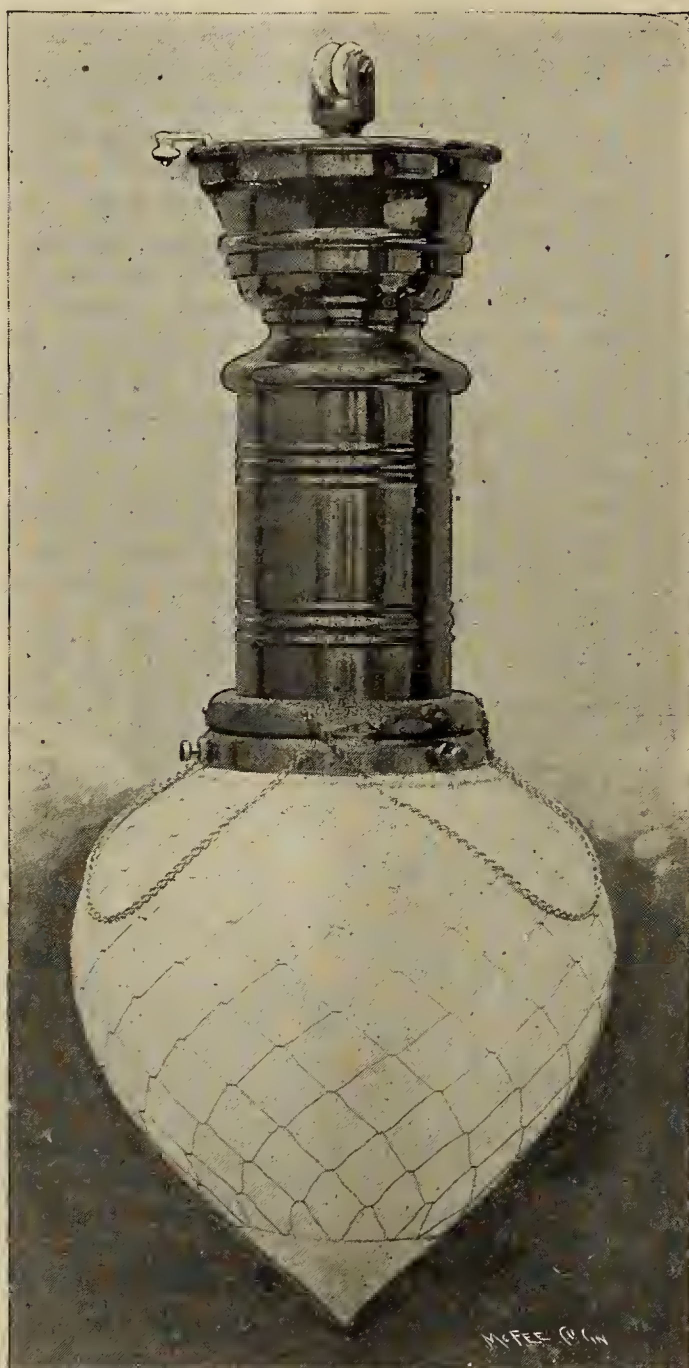
which gives us 2,000 turns with that frequency and induction required. The reduction of turns for the secondary follows in proportion of the pressures. The secondary in this case requiring one-fortieth as many turns; that is to say, 50. When the transformer is at full load the current circulates freely in the primary coil, and therefore in the secondary. When the load is off, the primary being always in circuit, still receives current, but to a very slight degree. The current passing through the primary increases automatically with the demands made upon the secondary. When the lights are gradually turned on, the secondary uses more current; the primary being sensitive to these conditions, receives more and thus keeps up without interruption the cycle of changes. Large power plants have been erected abroad and in this country that use this system of transformation and transmission. The Ferranti system in London is one of the greatest in the world.

FAST RUN ON THIRD RAIL.

Hartford, May 10.—The third-rail electric system, which President Clark of the Consolidated road asserts is to be an important factor in the development of railroading, and which, it is predicted, will at an early day largely supersede steam power in railroad travel, had a satisfactory test today. Interest in the matter was by no means confined to this country, for the officials of the road have been in receipt of frequent inquiries about it from railroad men abroad.

Runs were made over the track of the New England road from New Britain to Hartford, which had been equipped with the third-rail system, and all that had been claimed by the friends of the system was fully demonstrated.

The run of ten miles between New Britain and Hartford in the official trial was made in 13½ minutes and with less jar than is ordinarily experienced in passenger trains run by steam. Stretches of the route were covered much faster than a mile a minute and the motor car was geared to 85 miles.



Nowotny Inclosed Arc Eamp Type A. For Interior Service.

The trip was a pleasant one, and those who did not know the speed that was being made would have difficnlty in realizing that the car was running at such a high rate. Colonel N. H. Hoft, chief of the electrical department, was on the front platform and regulated the speed himself.

The cars are about fifty feet long. Each car has a chime whistle and a big gong at each end. Five cars are now on hand ready for running. Instead of an overhead trolley the electric current passes to the propelling machinery of the car by two shoes, thirty-three feet apart, which are in contact with the third rail.

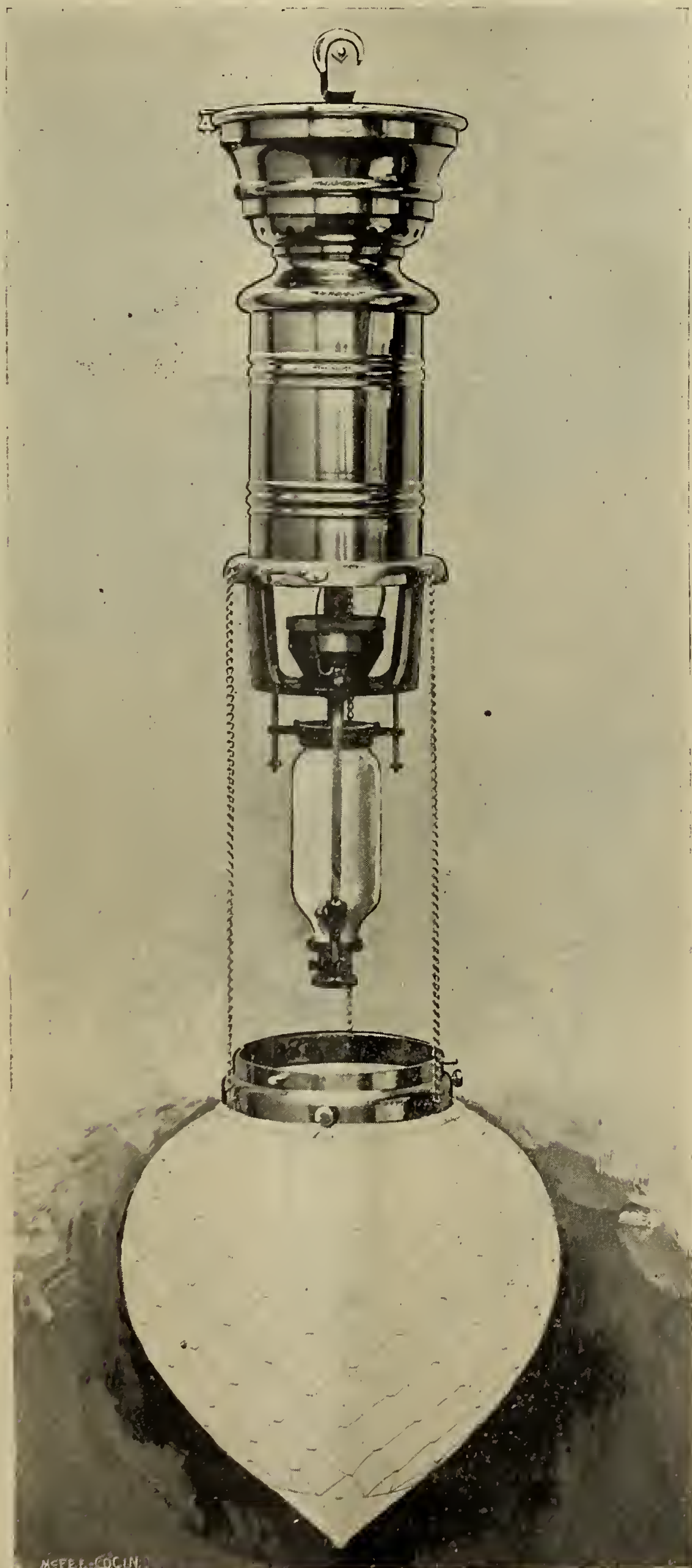
It was 1:30 P. M. when a party of about fifty, which in-

cluded President Clark, Vice-presidents Hall and Mellen and other officers and directors of the Consolidated and New England roads, reporters and other invited guests, boarded a car at the Berlin power house and started on the first trial trip.

The run of two and a half miles between Berlin and New Britain was made in less than six minutes. The start from New Britain to Hartford was made at 1:53, and at 2:06½ the train had stopped at the Hartford station and the members of the party were alighting. President Clark was most heartily congratulated upon the success of the trial.

NOWOTNY LONG-BURNING INCLOSED ARC LAMPS.

The revolution in arc lighting has occurred within the last two years. The improvement in the mechanism of the arc lamp became manifest earlier than this, but the completed lamp with its capabilities of fine adjustment and long hours of burning is but a recent product.



Nowotny Inclosed Arc Lamp with Outer Globe Suspended.

A lamp may be examined from two general standpoints—mechanical excellence and light efficiency. The simple experiment of Sir Humphry Davy gave to the

world the germ of today's possibilities; its crudities and difficulties unfolded themselves as the years rolled on. We can therefore, from a long and healthy experience, examine the Nowotny arc lamp as to the value of the mechanism and the illumination it gives.

The lamps in use in America exceed 350,000 in number. This gives a chance to the manufacturer to judge of the general deficiencies existing and to overcome them.

The operating parts of the Nowotny lamp contain no rods, chimney, gear wheels, etc. The carbon is securely held without the aid of a carbon rod; and the clutch consists of four porcelain balls, which regulate the movement of the carbon, themselves being held by a retaining receptacle. This device has all the features and performs the functions of an arc-maintaining ball-bearing piece of mechanism.

The lamp is ornamental in appearance; the one for outside use being weather-proof in every respect; thus insuring its wearing qualities.

The Nowotny lamp takes four amperes, four and a half amperes at 80 volts across the arc, with 110 volts pressure in the line.

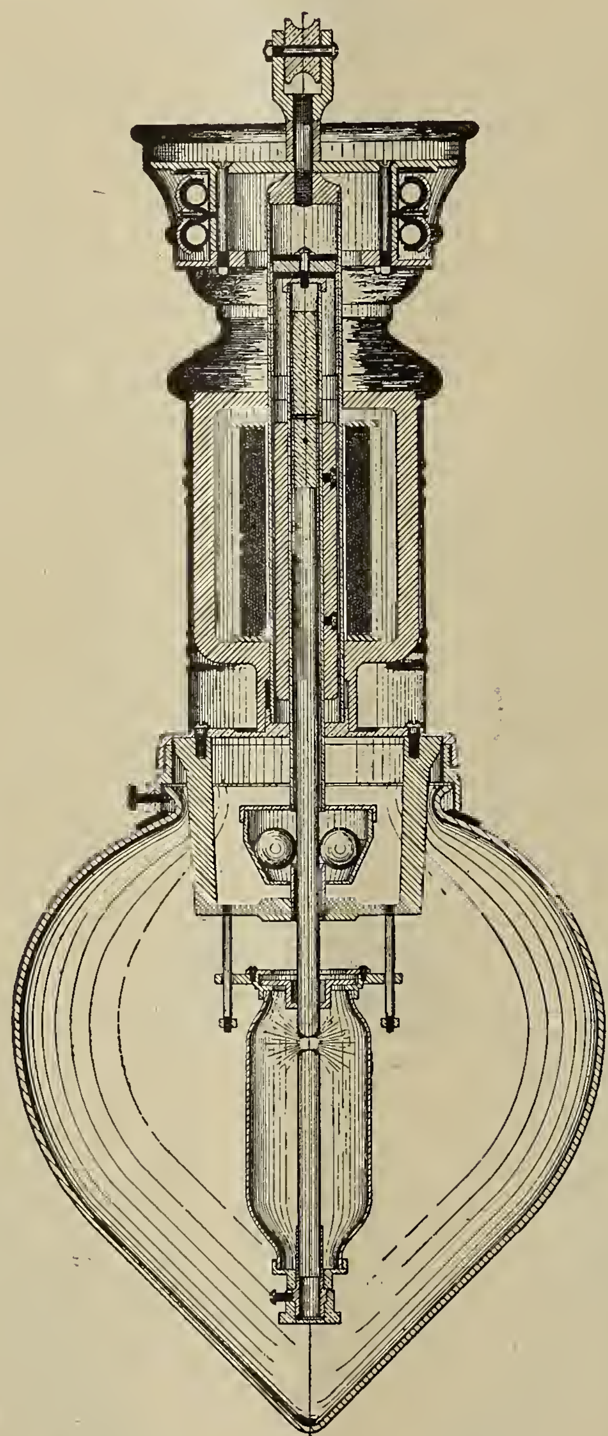
The lamp can be easily recarboned and the inner globe rarely breaks, as expansion and contraction are well attended to. The outer globe is supported by a ring at its top, so that it may be conveniently lowered while being securely held.

The economy in consumption of energy and candle-power produced is indicated by the following table:

						C. P.
4	amperes at 110 volts	energy consumed	440	volts,	1,600
4½	" " "	" "	495	"	1,800
5	" " "	" "	550	"	2,000

The Nowotny Electric Co. may be corresponded with at 208–210–212 Lawrence street, Cincinnati, Ohio.

E. P. Morris, New York Agent, 15 Cortlandt street.



Nowotny Inclosed Arc Lamp (Cross-Section.)

INTERESTING SUIT FOR DAMAGES FOR FAILURE TO DELIVER COPPER.

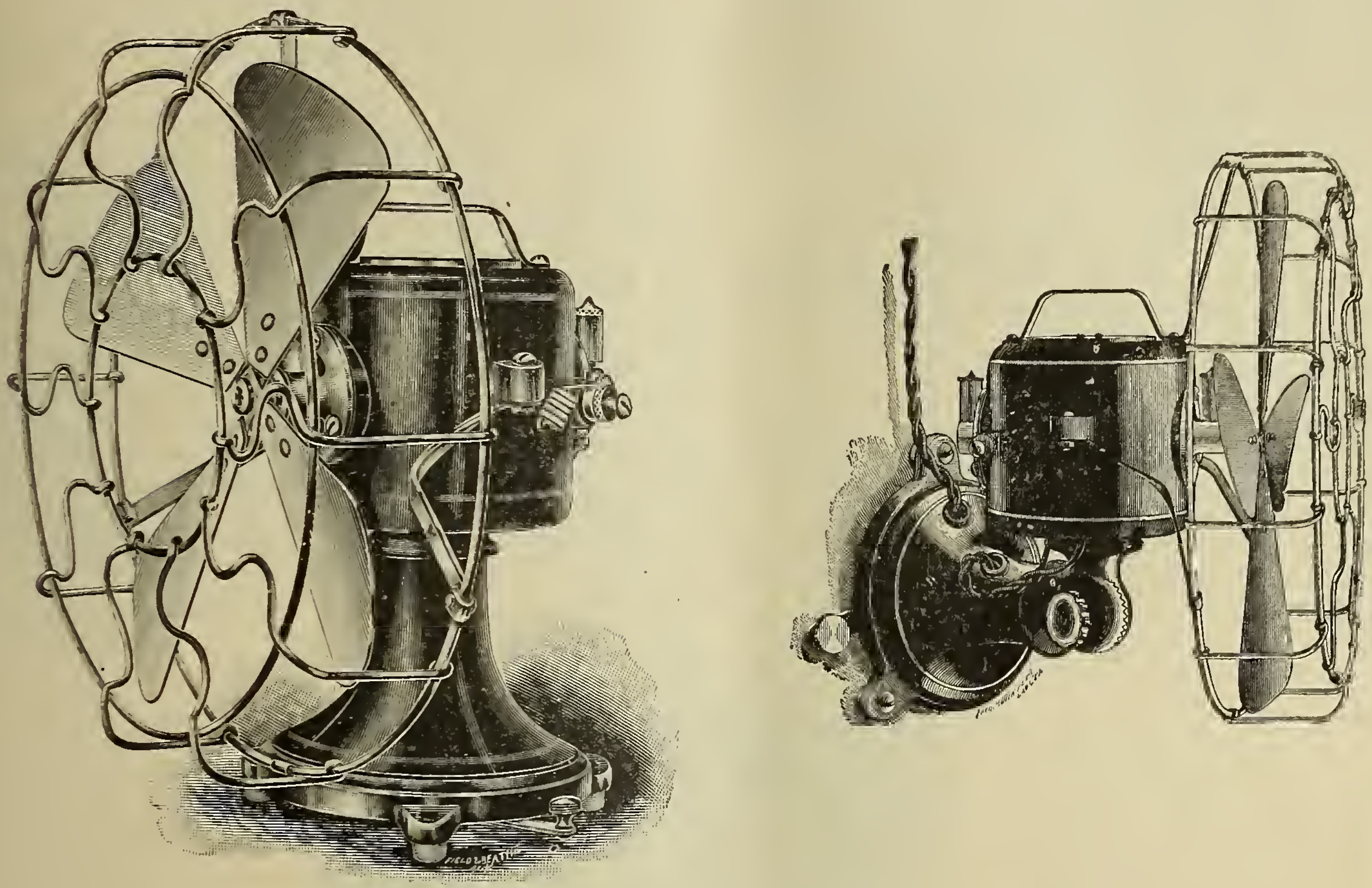
An interesting case in the Supreme Court of New York was disposed of this week by the discontinuance of the suit of the Okonite Company against Holmes, Booth & Haydens.

The complaint showed that in June, 1895, Holmes, Booth & Haydens sold to the Okonite Company 300,000 pounds of copper at 12¼ cents, and after delivering 50,509 pouuds, stopped further delivery. The Okonite Company then in September, 1895, purchased elsewhere the balance of the copper at 14 cents, and then sued Holmes, Booth & Haydens for about $4,500, the difference. Holmes, Booth & Haydens denied the contract. An order discontinuing the suit was entered in the Clerk's Office on the 21st, and on enquiry it is understood that Holmes, Booth & Haydens paid the Okonite Company about $2,800 for a settlement.

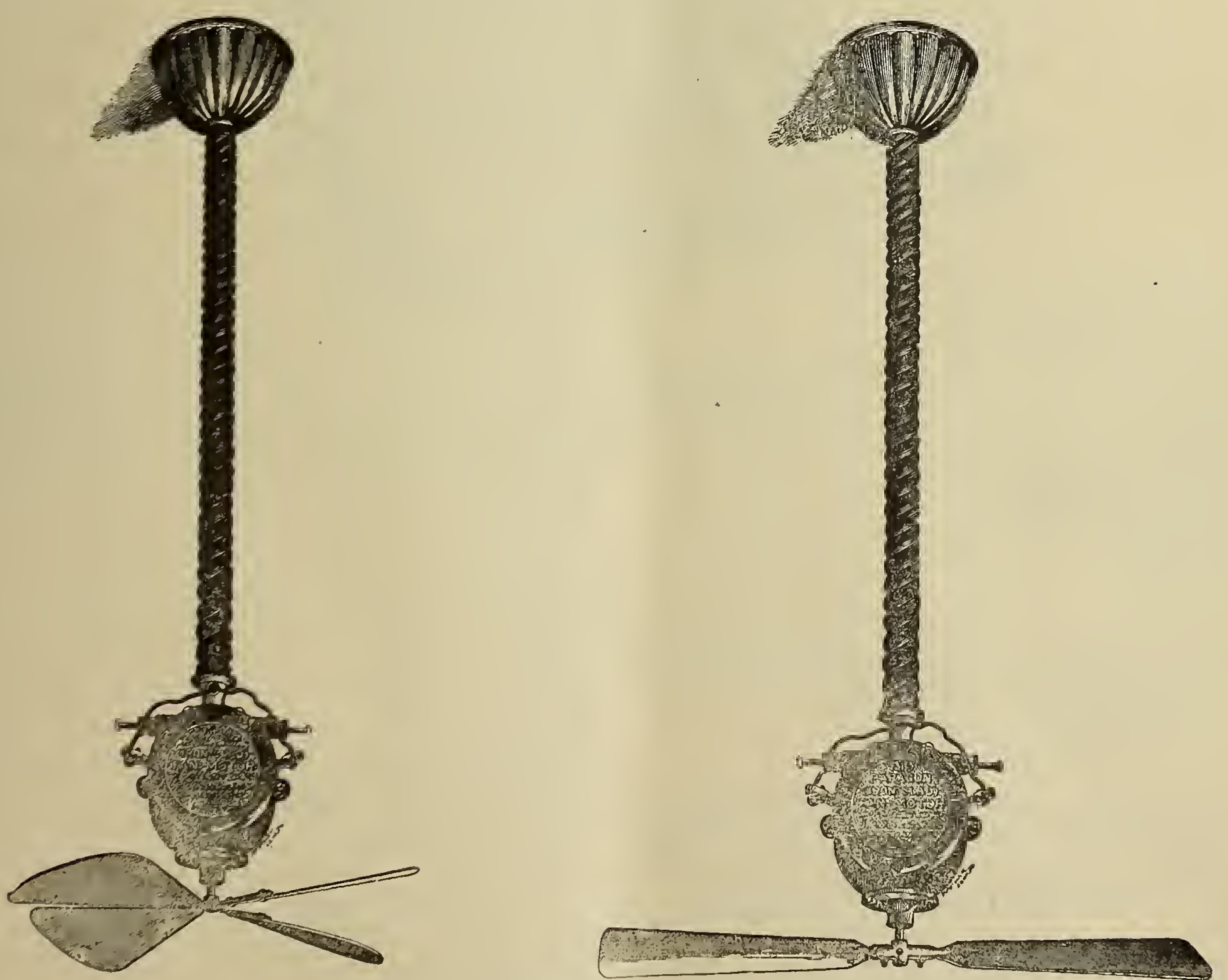
HAVE YOU SEEN THE GHOST?

Have you seen the ghost? is the expression down-town among the fan-motor trade. J. P. Williams, general agent of the Paragon (iron-clad) electric fan motors, 39 Cortlandt street, New York, has among his new paragon fan motors a white enameled fan motor called the Ghost, which is attracting unusual attention for its beauty of design, finish and construction.

Mr. Williams has brought out some very excellent designs this season. Particular attention is called to their new bracket fan motor; it can be fastened to a side wall and be placed in any position by means of a thumb-screw, allowing the breeze generated by the motor to be thrown in any direction. The same motor can also be used on the desk. These motors are finished in any color desired. He has a new ceiling fan with 36-inch wooden blades and furnished with any length of stem.



Paragon Desk and Bracket Fans.



Paragon Ceiling Fans.

His new Elevator Fan Motor with 16-inch fan is also a big attraction. It can be set close to the top of an elevator, taking very little room. The demand of the trade for this coming season calls for a cheap, efficient, economical and durable fan—one that will operate noiselessly, not get out of order, and all of these valuable features are combined in the paragon iron-clad fan motors. They are the result of several years' practical experience and a careful consideration of the requirements of the trade.

(Q.)—THE ECONOMICAL USE OF GAS.

Auburn, May 1, 1897.

Dear Sir: Can you give any figures on the relative vuantities of gas consumed in producing light, as follows:

In the burner,
By Welsbach,
With gas engine and dynamo,
By the air of a thermopile heated by gas.

A comparative table would be of the greatest service to me at present. Thanking you in advance, I am

Yours truly,
Frank A. Maas.

(A.)—The first and second in the list are familiar examples. The general rate of gas consumption would be represented by the following figures:

		Per hour.
In ordinary tip	5 cubic feet	16 C. P.
Welsbach	4 " "	16 "
Gas engine and dynamo, with incandescent lamps	3 " "	16 "
Gas engine and dynamo, with arc lamps,	50 " "	2,000 "
With thermopile	5 to 10 " "	16 "

These figures are only roughly approximate, particularly in the case of gas engine and dynamo, with incandescent lamps. The wattage of the lamps will determine the light given for a certain expenditure of energy.

Mr. C. H. McIntire, of McIntire & Co., No. 15 Franklin street, Newark, is going to Europe on the Steamer Germannic. He will be gone one month, for business and pleasure. The McIntire concern are the original manufacturers of terminals and connectors for telephone, telegraphic service, dynamos, etc.

Jellico, Tenn.—Mayor may be addressed concerning establishment of electric light plant.

THE SYNCHRONOGRAPH.*

A New Method of Rapidly Transmitting Intelligence by the Alternating Current.

BY ALBERT CUSHING CREHORE AND GEORGE OWEN SQUIER.

(Continued from page 292.)

Let us consider the advantages of thus operating upon an alternating current. It is evident that the advantages above mentioned of using a system subjected to a perfectly regular alternating electromotive foice, and capable, if necessary of transmitting considerable amounts of power, is by this method made available. In addition, no spark is made in a transmitter adjusted to break the circuit at the exact times indicated by the curve above, when the current is naturally zero. This makes it possible, if it is found desirable, to use comparatively large electromotive forces and currents on the line, for no matter what the maximum value of the current, it is made and broken by this plan with no sparking. It is also possible to employ waves of high frequency upon the line, the upper limit obtainable from an alternator being probably much higher than can be transmitted over the line.

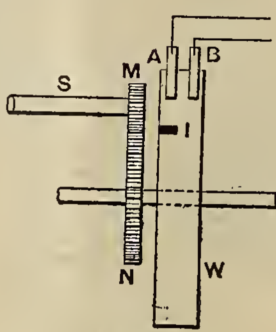


Fig. 5.

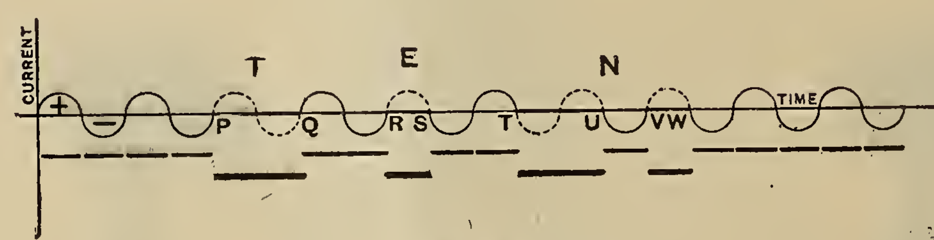


Fig. 4.

If a receiver were used which could reproduce an exact trace of the actual waves sent over the line, it might resemble such a combination as that represented by the heavy curve in Fig. 4. The sine wave continues uninterrupted to the point P, when the key is opened, and it is held open for one complete wave-length P Q, when it is again closed for a wave length Q R; then opened for one-half a wave-length R S; closed for a wave-length S T; opened for a wave-length T U; closed for half a wave-length U V; opened for half a wave-length V W and finally closed. By this plan it is possible to use the ordinary Continental code in telegraphy, a dash being indicated when two successive waves, a positive and a negative one, are omitted by keeping the key open, and a dot meaning where a single half wave is omitted. The space between parts of a letter, as between the dash and dot of the letter "n" is indicated by the presence of one-half a wave-length, and the space between letters as between "t" and "e" in the word ten," by the presence of two half-waves, while the space between words may be represented by the presence of three half-waves, and between sentences of four half-waves or more. The above is a single example, of which there are many, of a method by which the usefulness of so operating upon an alternating current is made apparent because it shows how these signals may be interpreted by a fixed code. It need not be said that there are other ways easily devised of interpreting the possible combinations of waves which may be sent in accordance with any code, and it is not our present object

to present a method which is deemed superior to others, but merely to show that the above plan becomes operative.

A consideration of the time required to send the word "ten" by the above plan shows that it corresponds to the time of eleven half-waves of current. If we suppose that the frequency is an ordinary one used in alternating-current work, viz., 140 complete waves per second, the time required to send the word "ten" is .0394 of a second, or, by allowing three additional half-waves for the space between the words, the word "ten" would be sent jnst 1,200 times in one minute. There is no difficulty in using over some lines a frequency four times as great as that ordinarily used, namely, as high as 560 or even 600 periods per second. This would correspond to speeds of 4,800 and 5,143 times sending the word "ten" per minute. The limit in each instance is only determined by the particular line used.

Hitherto it has not been pointed out how it is possible to manipulate a key at the high speed mentioned, so as to open and close the circuit hundreds of times per second as desired at the exact instants when the current is naturally zero. Evidently the proper place to manipulate such a current controller where the circuit must be made and broken at distinct points of phase, is at the generator itself, or in connection with any motor running synchronously therewith.

It will be sufficient for purposes of illustration to show by a special example how any single half-wave may thus be controlled at the generator; for obviously any word or sentence may be formed by a repetition of this operation.

In Fig. 5, S represents the shaft of an ordinary 10-pole alternating current generator which drives through the gears M and N, the wheel W. The circumference of this wheel is one continuous conductor presenting a smooth surface for brushes to bear upon. If the periphery of the wheel is divided for example into forty equal parts, and it is geared to run at one-fourth the speed of the armature, each division thereof corresponds to one semi-cycle of the electromotive force produced by the generator. Upon the wheel W bear two brushes A and B carried by a brush-holder which is capable of adjustment. These two brushes are connected in series with the line, so that the current which passes in at one brush is conducted through the wheel to the other brush, and thence to the line. The current used may be obtained from the generator, the shaft of which is represented at S, either before or after it has passed through any number of transformers, since it is the frequency alone with which we are concerned.

The line current is brought to the wheel W to be synchronously operated upon. If both brushes remain continually in contact with the wheel, the current transmitted would have the regular sine form represented in Fig. 1, and for each revolution of the wheel there would be forty semi-waves or twenty complete waves transmitted. If one-fortieth of the circumference of the wheel is covered by paper or other insulating material as indicated at I, Fig. 5, and the brush A adjusted to ride on to and off from this insulation just as the current is changing from one semi-cycle to the next, that is, changing sign, while the brush B is in continuous engagement with the wheel, the semi-cycle represented by the section covered will be suppressed, and without any sparking, even if the potential used is high. In practice, the brush A is easily adjusted to this point by moving it slightly backward or forward around the circumference of the wheel until the sparking ceases. This adjustment once made, the brush is fixed in position and so remains. In each succeeding revolution of the wheel, this cycle of operations is exactly repeated, and the current sent over the line would resemble that shown in Fig. 2, having every fortieth semi-cycle omitted. It is only necessary to cover other similar sections of the circumference of the wheel in a predetermined order according to a code, to transmit intelligence over the line. The above illustration of the operation of a transmitter on this principle is given for simplicity only, and is evidently far from a practical form of transmitter.

The wheel W in the above example may have different speeds with respect to the generator shaft, the essential condition being that its circumference shall contain some integer number of a unit, which is the arc upon the circumference of the wheel if geared to the armature, that a point fixed with respect to the field would describe upon it during one semi-period of the current. This wheel therefore might be connected to any shaft which runs in synchronism with that of the generator, as for instauce that of a synchronous motor if the power were obtained from a distance.

(To be continued.)

THE WEISS DRILL CASE.

The Weiss drill case has sixty round-bottomed receptacles, from No. 1 to No. 60, No. 1 holding 16 and No. 60 about 200 drills.

It is a drill gauge, has hardened and accurately ground bushings opposite each receptacle.

It gives the size of each drill in decimals opposite each bushing, and tells you the exact size of drill to use for all standard taps.

You see at a glance every drill in the case.

The cover, thrown down, will not slam, and raises at a tip of the finger.

It is an ornament. All in all it is a good thing.

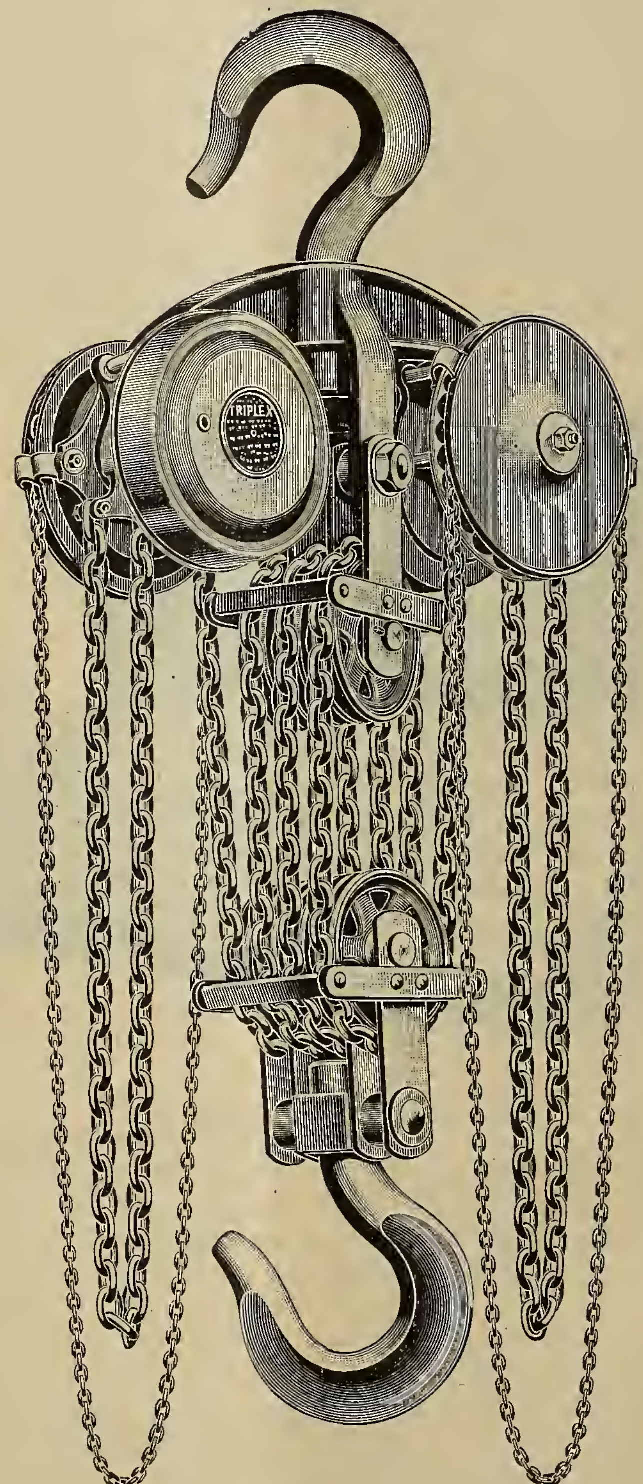
Manufactured and sold by Weiss Brothers, 286, 288 and 290 Graham street, Brooklyn, N. Y.

THE YALE-WESTON "TRIPLEX" CHAIN PULLEY BLOCK.

When the Triplex Chain Block was first introduced a report was published of tests made by Prof. R. H. Thurston, of Cornell University, to determine the relative "mechanical efficiency" of the various types of chain blocks in use, which disclosed the remarkable fact that while the efficiency of seven other types ranged from 18.9 per cent. to 32 per cent. (the Weston Differential Block being one of the highest), the Triplex Spur-Geared Block developed an efficiency of 79.5 per cent., or nearly threefold the average of other blocks.

load on each part does not exceed two tons. In like manner the maximum load on each hoist is limited to two tons, and this is the limit of load carried by each arm of the yoke. All the remainder of the load is suspended directly from the shank of the upper hook. This construction admits of greater compactness and occupies less headroom than any heretofore devised. Still greater compactness and from eighteen to twenty inches additional headroom can be obtained by omitting the upper hook and crosshead and building the block into the trolley of a hand crane or overhead tramrail system.

This ingenious application of the Triplex system adapts it to the largest loads for which portable hoists are usually required, and by reason of the duplication of the



The Yale-Weston "Triplex" Chain Pulley Block.

In order to meet the demand for blocks of large capacity and having high efficiency two new sizes of the Triplex block have recently been produced capable respectively of handling loads of sixteen and twenty tons. The construction consists in placing a yoke on the upper hook, each end of this yoke carrying a Triplex mechanism of two tons capacity and each mechanism being operated by an independent hand chain. The two slack ends of the hoisting chain are attached respectively to the two Triplex hoists. The first loop of this chain then passes around the driving sheave in each hoist and thence over two sets of intermediate sheaves, one set carried in the frame of the bottom hook and the other set in the frame connected directly with the shank of the upper hook. The number of parts of chain is such that the maximum

hoisting mechanism enables the full power of four men to be utilized either in lifting the maximum load at normal speed or lighter loads at great speed, whereas all other large hoists have heretofore had but a single hand chain, on which it is not possible to utilize effectively the power of more than two or at the most three men.

Boston, Mass.—Tbe Worcester Construction Co. is to build a trolley line in Kingston, Jamaica.

Branford, Conn.—A company is petitioning for the right to construct and operate an electric line in Branford.

Greenbush, N. Y.—The Greenbush and Nassau Electric Railway has applied for a franchise to construct and operate a line between this point and Nassau.

BERLINER PATENT DECLARED VALID.

EVERY age betrays its weaknesses, and this present period is not exempt, being unique because of the unexampled ferocity with which patent suits are carried on and the vast interests depending upon the court's decision in many notable cases. The law of the survival of the fittest reigns supreme in this particular field of activity. The foundations of concerns are being laid during this epoch whose solidity and vitality will compare well with the greatest of financial institutions, and whose far-reaching grasp will embrace the crystallized ideas of inventors still unborn.

The sum and substance of the following decision is to the effect that the Berliner patent applied for in 1877 and only granted Nov. 17, 1891, is valid.

The claim of the government that the delay was illegal and the ensuing lawsuit, resulted unfavorably against them. The conclusions reached give the patentee control over all the battery transmitters.

The following statement was prepared by D. J. Brewer:

THE SUPREME COURT STATEMENT.

Mr. Justice Brewer:

I am directed to deliver the opinion of the court in No. 344, the United States vs. the American Bell Telephone Company and E. Berliner.

This was a bill filed by the government to set aside a patent issued to the telephone company as the assignee of Berliner on a patent issued in 1891. The grounds of relief set forth in the bill are that the delay of the application in the office for thirteen years was, under the circumstances alleged in the bill, unlawful and fraudulent; that the invention embraced in the patent of 1891 was included within a patent issued in 1880, and that the patent as issued was not for the invention described in the application, and also that taking the application to date, from the time when it was made by amendment to cover the invention described and claimed, it was barred by public use for more than two years.

We hold in this respect, to a suit to set aside a patent for an invention, that as in cases brought to set aside patent for land, the government must establish the grounds of relief by testimony which is clear, convincing and satisfactory, and not upon a mere preponderance of testimony.

We also hold that there is no evidence in the record—not the slightest—that there was any corruption or undue influence exercised by the officials of the telephone company to secure any delay in the Patent Office; that there is no evidence which justifies an inference that the delay was either at the instance or with the procurement or at the solicitation of the telephone company, or its officials, and that whatever delay there was, was caused by the action of the officials of the Patent Office, for which the telephone company is not responsible.

We hold, therefore, that there is an absolute failure to show any wrong on the part of the telephone company in this delay in the Patent Office, and as to the other ground of attack, they are matters which, under the statute law, are open to every individual to set up in a suit brought against him by the holders of the patent, and that so far as these particular matters are concerned, they are not such as to justify the interference of a court of equity to set aside the patent.

The decree of the court below is affirmed.

Mr. Justice Gray and Mr. Justice Brown did not hear the argument and took no part in the decision of this case.

Mr. Justice Harlan dissents.

The following extract from one of the leading dailies is very interesting:

Washington, May 10.—The Bell Telephone Company won the case brought against it by the United States to annul the last Berliner patent.

This decision has the effect of continuing the control of the telephone by the Bell Company for seventeen years from the date of the last patent, which was granted in 1891. The Government asked to have the patent of 1895 set aside on the ground that the delay of thirteen years in the Patent Office was fraudulent through the fault of the telephone company, and that the patent issued in 1880 covered the same ground on which the new patent was applied for in 1891. The Court holds that there was no evidence of corruption or undue influence exercised over the Patent Office by the telephone company.

Extensive Interests at Stake.

The decision by the Supreme Court sustains the lower courts. The case has attracted wide attention because of the extensive interests involved in its settlement and the opinion of the court has been anxiously awaited. The suit, it was claimed, involved the practical control of the art of telephoning. It originated in a charge of collusion in the Patent Office and was brought to obtain the repeal and cancellation of letters patent of the United States No. 463,569, dated November 17, 1891, granted to the American Bell Telephone Company as assignee of Emile Berliner, the alleged inventor. The repeal and cancellation of the patent were sought upon the ground that the application for it, while filed in 1877, was not issued until 1891.

It was claimed that the Berliner patent practically controls telephony, as it has to do with both the transmission and receipt of sound, and that the delay thus secured until 1891 operated to prolong the control for fifteen years beyond the time of the expiration of the Bell patent.

Origin of the Famous Suit.

It was also asserted that the patent was granted by the Commissioner of Patents without authority of law, and that it was for the same invention for which a patent had been granted in 1880, and that the principle was therefore not new.

With this favorable decision it is expected that Bell Telephone stock will advance. It certainly keeps competitors out of the field, particularly shutting out the Western Union Telegraph Company should it wish to embark in the telephone business. It is claimed that the Western Union has kept the Bell company out of the telegraph business since the contract expired between the corporations on November 1 last by a threat of going into the telephone business. The decision, therefore, places the Western Union at a double disadvantage.

The Bell company is already in the telegraph business to a limited degree. The Bell company owns the best system of telephone wires in the country. To combine the telegraph and telephone business would be a simple matter. Should the Bell company decide to take such a step it would work great harm to the Western Union company, which would be unable to retaliate owing to the Berliner patent, which is now declared valid.

Staunton, Va.—The Staunton Mutual Telephone Co. has been incorpora ed, with William Patrick president, N. C. Watts secretary and treasurer; to establish telephone system.

New York, N. Y.—Henry E. Howland, President Board of Managers, Manhattan State Hospital, may be addressed concerning installation of new electric lighting mains for hospital.

April 30, 1897.

Electrical Age Publishing Co ,

Dear Sirs: The relays used in telegraphic work are used for the purpose of boosting the current. Why is this necessary if the line is well insulated? The insulators used are made of glass, which I understand to be excellent non-conductors; how, then, is there so great a loss that relays are required? By giving this your attention you will oblige,

Yours truly,
A Subscriber.

(A.)—The relay is used for the purpose of throwing in circuit a local battery. The current leaks away all along the line *through the insulators.* An example will serve to illustrate the manner in which a slight loss grows in a long line.

Take a line 1,000 miles long with 30 insulating supports to the mile, each insulator having ten megohms resistance.

$$\text{No. of supports, } 1{,}000 \times 30 = 30{,}000$$

$$\text{Insul. resistance of line} = \frac{10{,}000{,}000}{30{,}000} = 1{,}000 \text{ ohms.}$$

The insulation resistance of a line is lower than this in reality, the insulators being poorer; after exposure becoming dirty and therefore better conducting. The comparison to be made is that between the conductivity of the line and the insulation resistance of the supports.

A copper line need not have such good insulators as an iron line. The current has two paths to choose from, through which current flows according to the resistance.

REMOVAL NOTICE.

68 Cortlandt St., New York, April 1, 1897.

We beg to inform you that on May 1, next, we will move to 204 Fulton street, (near Church street), at which place our facilities will be much larger and enable us to carry a more complete line of our packings, steam specialties and supplies for immediate delivery.

We hope for a continuance of the many favors extended to us in the past.

Respectfully yours,
Jas. L. Robertson & Sons.
Successors to Hine & Robertson Co.

I desire to announce to my friends and the trade that on May 1st, 1897, I will consolidate my business with that of the Chapin-Douglas Electric Co., under the firm-name of the Columbia Electrical Supply Co., with main store and stock as heretofore at No. 329 Fourth avenue, and down-town branch with telephone connection at 136 Liberty street, until further notice, where a stock of supplies will be kept for the convenience of customers.

With the increased stock and improved facilites, the Columbia Electrical Supply Co. will be able to handle your esteemed orders to your entire satisfaction.

I request a continuation of your favors, and remain,

Respectfully,
T. M. R Meikleham.

NEW YORK ELECTRICAL SOCIETY.

Office of the Secretary, 203 Broadway, New York.

The New York Electrical Society was organized in 1881, "for the advancement of electrical knowledge and the study of electrical and other scientific phenomena."

In carrying out this purpose, the endeavor of the officers of the society has been to make it a help and a stimulus to young electricians, and an up-to-date means, for the general public, of discussing and illustrating the most recent and interesting developments in electrical work.

Any person of good repute, who is connected with or interested in electrical work, is eligible for admission to the society. An application blank, which will be forwarded by the secretary on request, must be filled in with the name, address and occupation of the applicant, and returned. The name will be endorsed by a member and duly presented for election. The entrance fee is $1, and the yearly dues are $3.00.

It is well known that from the inception of this body to its one-hundredth meeting in 1887, a standard of papers and discussion was set which established the reputation of the society as exerting a most beneficial influence in the dissemination of current electrical knowledge and progress.

An interesting little paper devoted entirely to telegraphy, called The Telegraph Student, has reached us. It comes from Oberlin, Ohio. Its title-page reads "Devoted to Telegraphy from a money-earning standpoint and to the interests of the Oberlin Telegraph School."

Sherbrooke, Ont.—Mr. Burke, president of the Sherbrooke Electric Street Railway Co., states the work is likely to be commenced at an early date and to be completed before August.

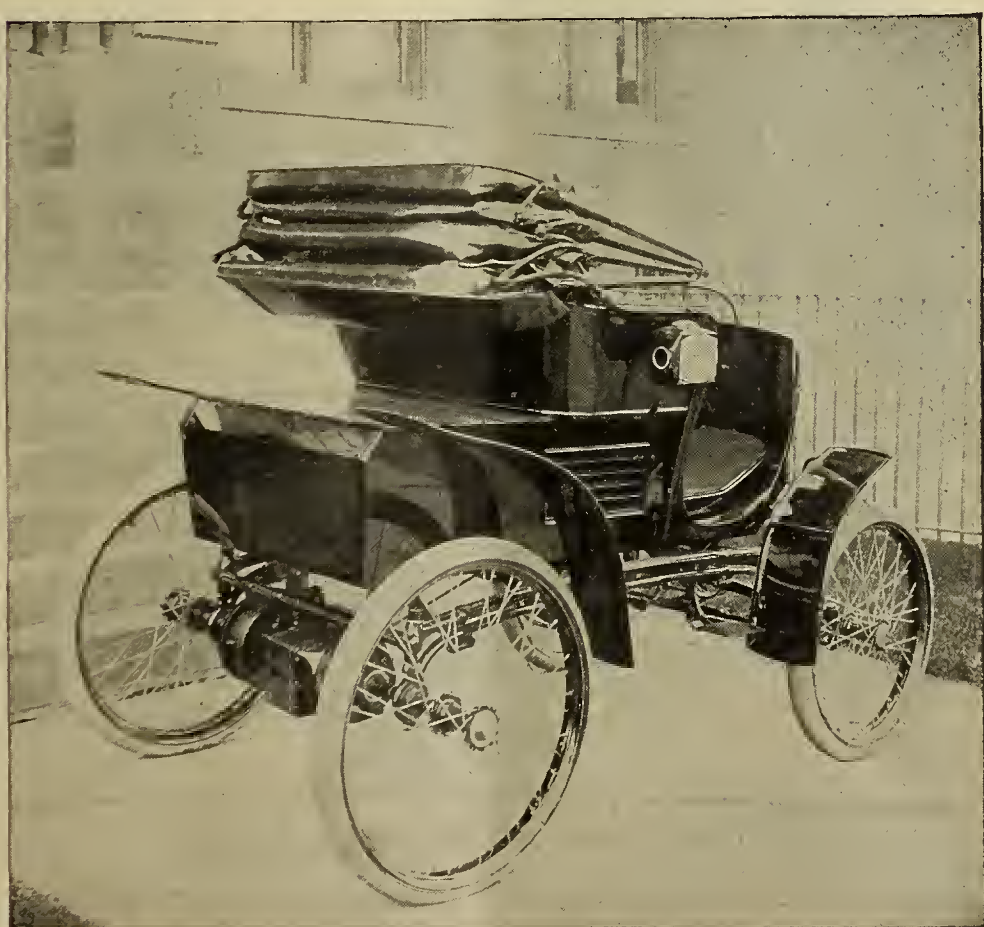
Brinkley, Ark.—Brinkley Electric Light & Power Co., damaged by fire at a loss of $3,000. Not insured.

Owensville, Ind.—J. P. Cox, Town Treasurer, may give information concerning electric light plant.

The Electrical Age.

VOL. XIX., No. 21. NEW YORK, MAY 22, 1897. WHOLE No. 523

Columbia Motor Carriage.



Columbia Motor Carriage.

COLUMBIA MOTOR CARRIAGES.

The bicycle will be equalled in popularity very soon by the motor carriage, in reference to which this article has been written. The Pope Manufacturing Co., of Hartford, Conn., with their usual foresight have been looking up motor carriages since January, 1895. At first gasolene carriages occupied all their attention, but they became satisfied that the use of this fuel as a motive power was neither safe nor desirable for general service.

A great number of gasolene carriages are on the market at present, and the consuls in France, England and Germany are kept busy keeping track of the races, experiments, etc., made by the competitive owners.

The abandonment of gasolene and the adoption of electricity as a safe and reliable source of power is another feather in the cap of the electrical profession and a sign of intelligent progress on the part of the Pope Mfg. Co. They have put upon the market a carriage which is in reality the only operative one available.

The storage cells used have been chosen from the leading concerns in the business. The motors are particularly well adapted to the work they are made to perform, and have undergone many severe tests for the purpose of showing their desirability and power.

The carriage is made entirely on a bicycle basis, that is, the use of pneumatic tires, ball-bearings and all that adds to lightness of weight and speed. The frame is made of Pope Tube Co.'s .50 carbon steel, selected of a size to be used in an annealed state. The carriage has a radius of action covering over 30 miles. The speeds are of the following rates :

15 miles an hour, on smooth, level roads.
12 " " " " " "
6 " " " " " "
3 " " " " " "

The batteries are charged at any 110 volts source of supply, and therefore may be readily attached to any one of the many private or station circuits so numerous in large cities, towns, or the homes of private individuals.

The cost of operation, according to the rates charged for current in large cities, is 1¼ cents a mile.

Train of Motor Car and Coach at Berlin. (Courtesy of N. Y. World.)

If a plant is owned by the proprietor of the carriage the cost does not exceed ½-cent a mile. No error can be made in charging and they cut themselves out automatically when fully charged.

The carriages are entirely available in the most severe weather, and while their radius of action is, of course, necessarily reduced, 6 or 8 inches of heavy snow is no obvious obstacle and the same is proved to be true of mud. These statements are not a matter of surmise but the result of actual daily use without restriction of the preliminary carriage constructed by us, which has now made a record of about 3,500 miles and has never sustained an accident so severe as to prevent its return with its own power. Incidentally, the endurance of the batteries was well demonstrated by this experience, and although they were carefully examined a few days ago they show no signs of deterioration which would prevent the belief in their availability for an indefinite period longer.

Nothing could be more severe than the treatment which this carriage has received, more especially the batteries, and it has been not uncommon for the carriage to run for several hours at a rate of discharge double the normal. Nothing is more severe than this upon the life of a storage battery.

The luxury of travel has been so enhanced by the use of motor carriages that the near future will find them in use to the same extent as the cab and barouche with their prancing steeds are today.

The enterprise of the Pope Mfg. Co. is worthy of commendation and will meet with practical appreciation from those possessed of a similar spirit.

Bar Harbor, Me.—A new electric light station will be erected at a cost of $7,000.

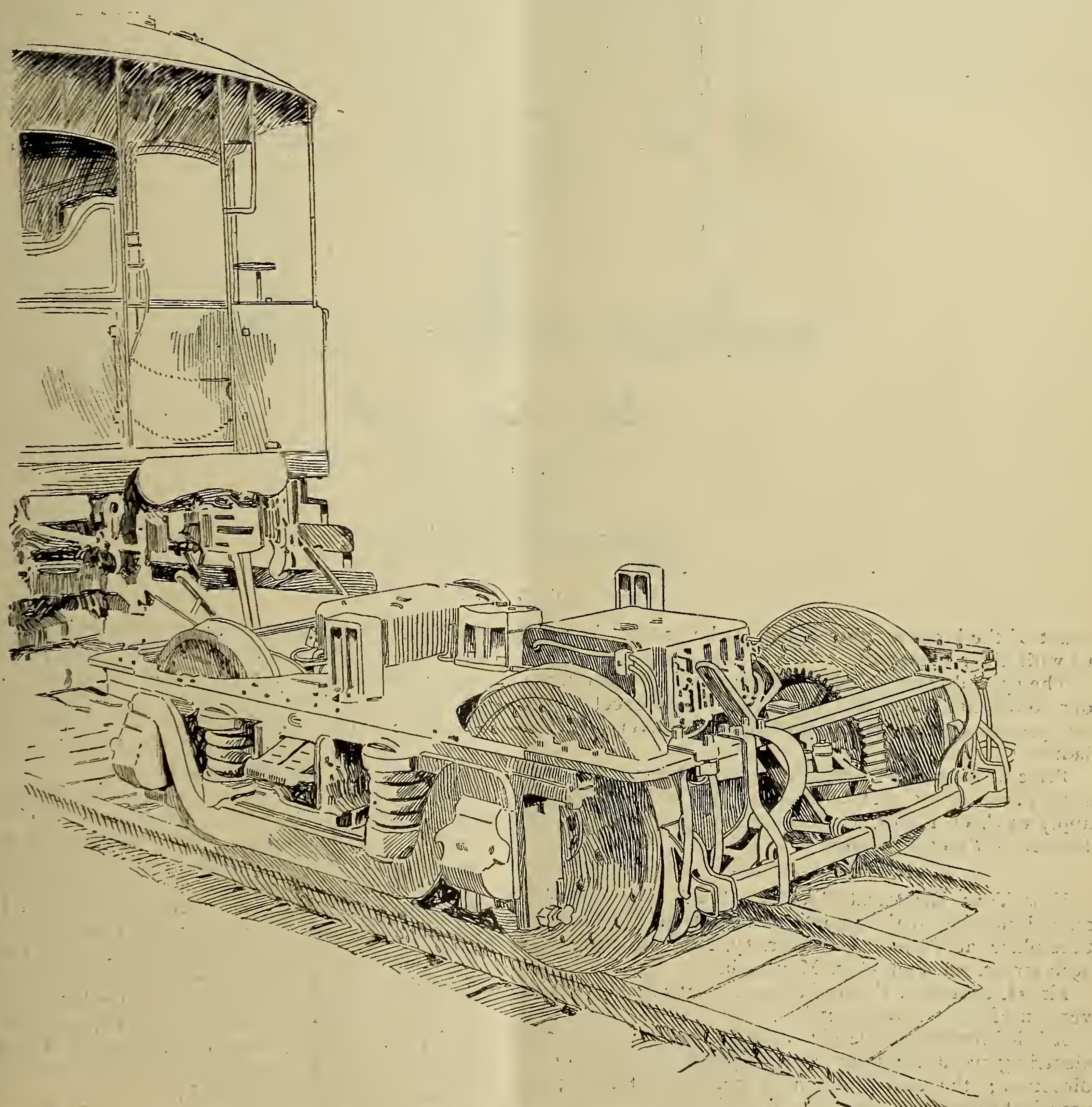
St. Louis, Mo.—An electric line will be established, beginning at Broadway and North Market street, and running over North Market street, Blair avenue, Benton street, Garrison, Cass, Prairie, Evans avenue, etc.

ELECTRICITY ON THE NEW HAVEN ROAD.

Stephenson's star is waning. The beginning of the end is approaching, and the gradual transition from the puffing steam engine to the noiseless electric car will continue until the change is complete. The New York and New Haven Railroad have finished a 13-mile length of road, employing the third-rail system, which has withstood the test made upon it most successfully. In the words of Pres. Charles P. Clark, of the New Haven Railroad:

"You may tell everybody who is engaged in investing his own or anybody else's money in lines competitive with steam roads that they cannot prosper when the day comes to lay down third rails in this country. There is neither malice in this statement nor a desire to injure anybody. Our locomotives may go into the scrap heap, as the old stage coaches had to go."

The following illustrations give the reader a general idea of the appearance of the road, the motor truck and the section of the roadbed with third rail. In 1894 President Clark began his experiments near Nantasket Beach; the results were satisfactory, and in 1896 the third-rail system was tried. The new branch of road is supplied with power from a station erected at Berlin, a short distance from the main line connecting New Haven with Hartford.



Truck of Motor Car with 125-Horse Power Motors. [N. Y. World.]

Four cables connect from the power-house to the third rail and tracks. The third rail weighs 93 pounds to yard, is insulated from the ground, mounted upon cone-shaped block of wood that have been well creosoted. These blocks are mounted on wooden pins set into the ties.

At crossings the third rail is omitted and a copper cable about one inch in diameter is substituted. The motors used are 125 horse-power apiece, each car being equipped with two of them.

These cars fully mounted can carry about one hundred passengers. The current passes from the third rail to a piece of flat iron called the shoe, supported beneath the truck by two links. It is about 12 inches long and weighs 20 pounds. The third rail is well flattened on the top, to make proper contact with the shoe. The speed obtainable is approximated at 100 miles an hour.

N. E. L. A. CONVENTION NOTE.

(Railroad Fares.)

The Trunk Line Association, the New England Passenger Association, the Central Passenger Association and the Southern Passenger Association have made a rate of a fare and one-third, on the certificate plan, from all points in their territory to Niagara Falls and return for delegates to our twentieth convention, to be held at Niagara Falls, June 8, 9, 10. In purchasing tickets ask for a certificate, which will entitle the purchaser to be returned at one-third the regular fare.

The arrangement for a special train has been a somewhat perplexing question, owing to the desire that our members should enjoy the best possible service at the lowest possible rate. After long and continuous negotia-

tions, a most satisfactory arrangement has been made with the West Shore Railroad to run a special train of vestibuled parlor, library and dining cars, leaving New York (foot Forty-second street, North river, at 10.15 a. m., and foot Franklin street 10 a. m.) Monday, June 7. Tickets to return via West Shore R. R. or New York Central and Hudson River R. R., thus enabling the delegates who take this train to enjoy the view of both sides of the river, if they so desire.

The daylight run was decided upon owing to an almost unanimous request on the part of our members, on account of the large number of ladies who propose honoring us with their presence.

The special train has always been one of the features of our conventions, and this one promises to excel any of its predecessors, even to providing a souvenir for the ladies.

Price of tickets to Niagara Falls, including parlor car seat, $10. For ticket and parlor car accommodations apply to C. O. Baker, Jr., 126 Liberty street, New York, Master of Transportation.

New York Electrical Society, 182nd Meeting.—The annual meeting of the society and election of officers will take place at Columbia University, Madison avenue and 49th street, on Thursday, May 20th.

Mr. H. Barringer Cox will lecture on "The Direct Conversion of Heat Into Electricity."

A brief review will be given of the history of thermo-electric generators; the reason of previous failure in this direction; the real problem of thermo-electricity; the practical mission of a successful device.

Thermo-electric generators will be shown in actual operation, furnishing current to fan motors, X-ray outfits, medical apparatus, telegraph sets, annunciator systems, and other devices in ordinary use and every-day demand.

The regular business of the meeting will be taken up at 7.45 p.m., and the lecture will commence at 8.

George H. Guy, Secretary.

Oxford, Md.—An electric light plant will be established.

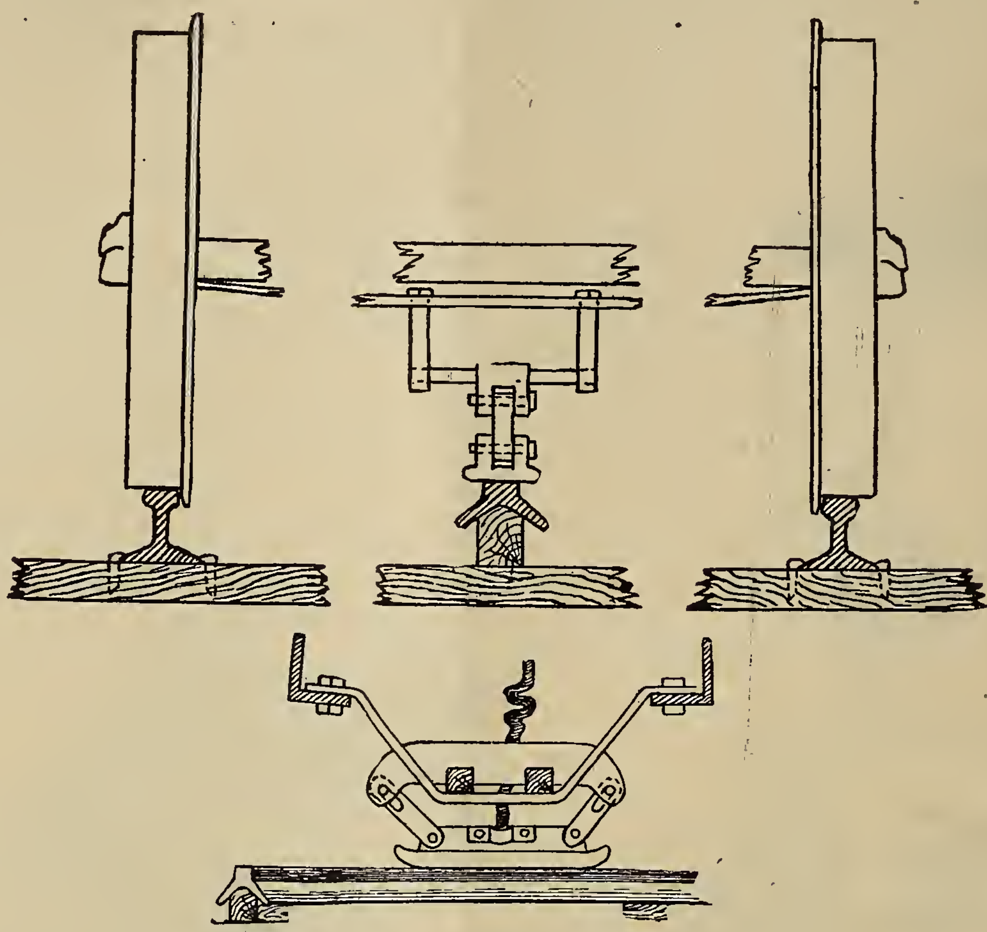
Beaver, Pa.—An electric light plant will be established.

MODERN OVERHEAD CONSTRUCTION.

BENJAMIN WILLARD.

(Continued.)

Wood poles for curve construction would be made similar to those specified heretofore for straight-line construction, excepting dimensions of such poles should be 31 ft. long by 14 ins. x 14 ins. at the butt, 9 ins. x 9 ins. at the top, chanfered from a point 14 feet from the base to the point, terminating in an octagonal form and roofed evenly for a space of three inches. Such poles should be set seven feet in the ground and raked 12 ins. from the perpendicular in a direction radiating from the centre of curvature, where strain is required. The hole should then be entirely filled with about seven-tenths of a cubic yard of broken rock and well rammed.



Details of the Third Rail and Shoe.

The holes for eye-bolts should be bored in wood poles before their erection, and should be bored so that the bolt will incline slightly downward towards the eye, to prevent the water from following in and rotting the top of the pole. The correct location for eye-bolt holes would be determined by the height at which the trolley wire is to be placed; 22 feet from the base of the pole would be correct, assuming that we allow two feet for drop in the ear-body and ear and also dip in the span, which would make the height of trolley wire about 20 feet. To facilitate the setting of poles to a uniform height it is a good plan to place grade stakes near the location selected for poles, indicating a given height relative to the grade of the track.

Centre pole construction is required in many locations and may be more adaptable than other methods, but I consider span construction better owing to its flexibility and for being less unsightly. There are now on the market appliances for making bracket suspensions flexible, which are an improvement over the old type of rigid construction. One of the most practical which I am familiar with is an attachment to receive a short span of flexible wire and the ordinary straight line hangers.

Poles used for centre and bracket construction should be made according to the same specifications as those used for span construction, excepting that an ornamental pole top would be required for the steel pole instead of an insulated one. Much can be spent on ornamentations

on centre and bracket construction, but it always occurred to me that the most practical is ornamental enough and places the cost where it will do the most good. For the bracket arm a 1½-inch pipe of the required length attached to a malleable iron collar made in halves and encircling the pole, and supported by truss rods leading from the end and centre of the arm to near the top, makes excellent and neat appearing construction.

Wherever guard wires are required it will be necessary to leave about two feet additional space on the top of the pole, above where the trolley span wires are attached, for the attachment of the guard wire span. It would hardly be practical to provide an insulated pole top to provide for both span wires, so the trolley span would be supported by means of a wrought iron clamp collar encircling the pole at the proper point and provided with suitable insulating fastenings. I do not especially approve of this method of construction (as I do not favor guard wires), but I would recommend it where it is compulsory to erect guard wires.

All poles should be painted with one coat before their erection, as it affords better opportunities to carefully apply the priming coat and at less expense than after the poles are set. A paint of dark green composed of graphite mixture I find to wear well and, although it costs more than some other paints, it has better lasting qualities (especially in iron work). A second coat of this paint after the poles are erected will cover marred places made necessary in setting, and will look well and last for at least two years.

Span Wires.—Span wires necessary for trolley suspension should be flexible steel five-sixteenths of an inch in diameter, composed of seven strands of No. 12 galvanized wire, and when under strain with conditions of pole setting as I have stated would have a tension of about 750 pounds when erected. Whereas I have allowed eighteen inches for sag in the span, it probably would not be over 12 inches at the time the wire is first suspended, but will gradually sag more as the wire stretches and the poles spring or yield in the ground; so if a 40-ft. span is attached 22 feet above the rail surface, the trolley wire within the course of a year would measure approximately 20 feet above the rail.

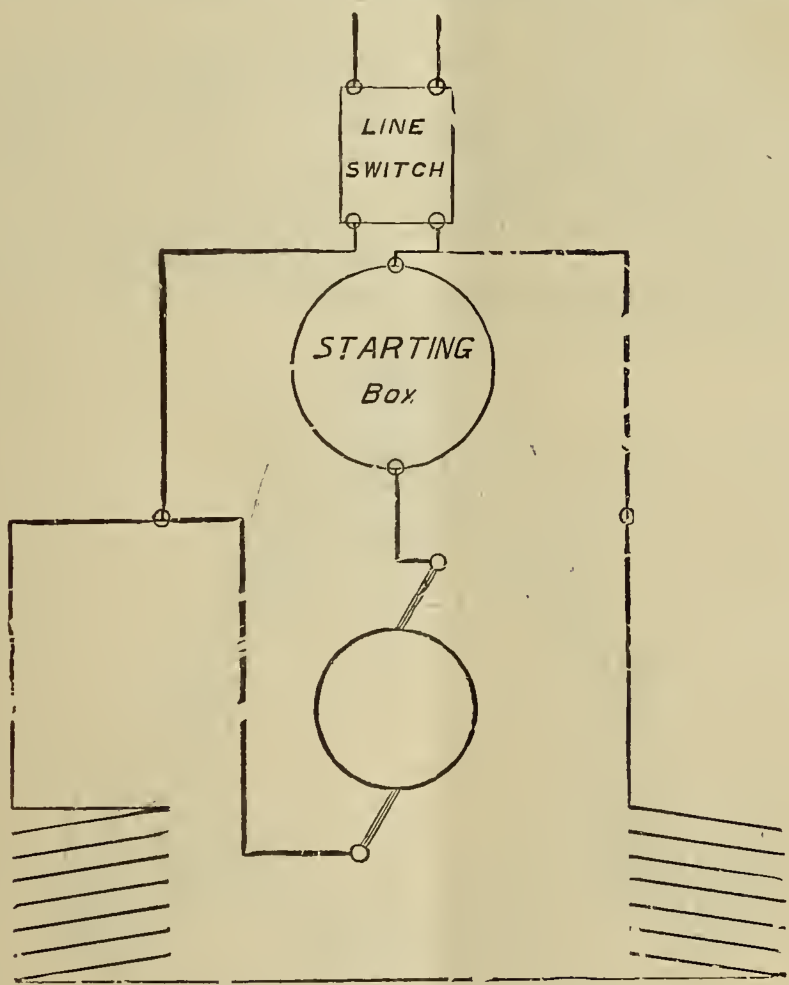
(To be continued.)

MOTORS, DYNAMOS AND THEIR CLASSIFICATION.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

If a motor be considered as a machine in which electrical energy is converted into mechanical energy, its convenience and usefulness cannot be misunderstood. There is at present no device of equal efficiency. Its rating is of the highest order and its universal application a matter dependent entirely upon the cost of electricity. There are many types of motors and dynamos on the market, whose points of excellence may be critically examined.



Connection of a Shunt Motor.

The general classification of the windings and a division of the magnetic circuits into groups is most instructive to the lay reader.

Windings.—The dynamo and motor are both made up of two distinctive parts,

Armature,
Field.

Each of these has a distinct function to perform. The armature, by rotation or otherwise, cuts the lines of force and thus creates within its turns an electrical pressure commonly called electromotive force.

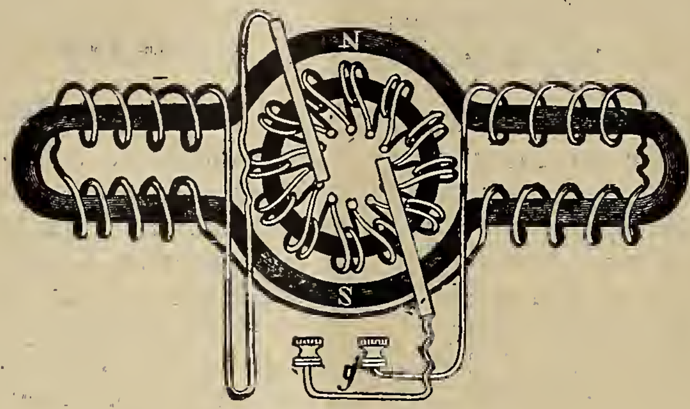
In the great majority of dynamos and motors the armature revolves, and thus performs the work it was intended for.

The field is of a different construction from the armature in this respect, that it simply supplies magnetism or lines of force to the armature. The greater the strength of this magnetic field the higher the speed of the armature, and the greater the number of turns on the armature the higher will be the electromotive force (E. M. F.) produced.

The field merits our first attention; it is generally wound in three ways:

Series,
Shunt,
Compound.

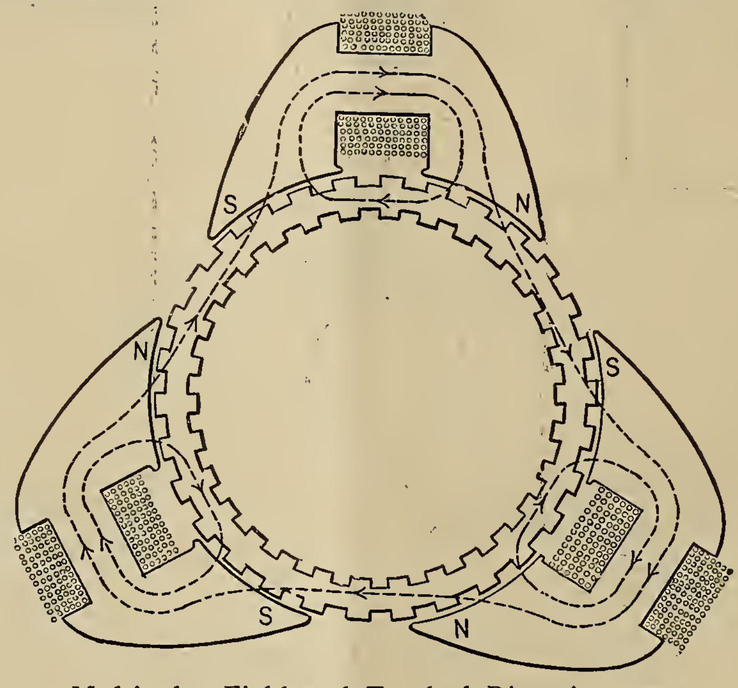
Series Winding.—The series winding is one in which the *entire* current from the armature flows around the magnet winding, both being connected in *series* in order to obtain this result. Also, if used as a dynamo, the current which issues from the armature passes through lamps, etc., before it reaches the field.



Connections of a Simple Series Wound Motor.

Therefore, we have a complete series circuit, from armature through outside circuit, through field back again to armature. Arc light machines are series wound and in the Thomson-Houston, Brush, Excelsior and Wood dynamos this winding is characteristic.

Shunt Winding.—This type of winding, as its name implies, is in shunt or multiple with the terminals of the dynamo. The field magnets are wound with a size of wire whose resistance prevents it from taking more than enough current to provide the magnetic field required. The current from the armature splits up into two parts. One portion, which is the greatest, supplies the outside lines with current. The other portion is taken away by the magnet winding. The amount required for this purpose varies in dynamos of different sizes from forty per cent. to two per cent.



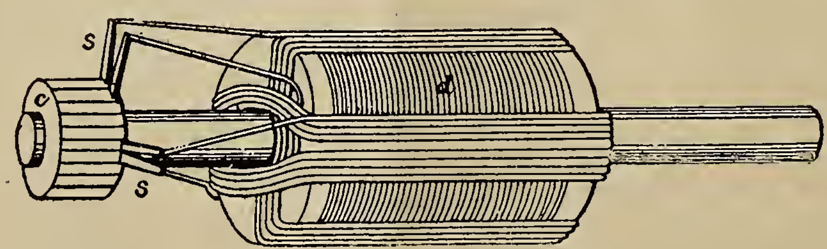
Multipolar Field and Toothed Ring Armature.

Nearly all continuous current incandescent light machines are shunt wound. Such types as the Edison or General Electric dynamo, the Eddy, Walker, Card, etc. This reference applies only to the magnet, or, as it is generally called, the field winding. The greater number of continuous current motors are shunt wound.

Compound Winding.—To obviate certain difficulties in incandescent lighting, such as armature reaction, loss of pressure in the armature and loss of pressure in the lines; a winding partaking of the nature of both series and shunt, called compound winding, has been adopted. Its inventor, Brush, was the founder of a great arc light system. In a dynamo the field winding may be to a certain extent neutralized, due to the fact that the armature carrying current also acts as an electromagnet.

It sends its magnetic lines oppositely to those produced in the field, and thus reduces the effective or resultant field more and more with each increase of current.

The current proceeding from the armature is made to regulate the machine in a very ingenious manner. The coil effects just described may be compensated for by a device which will strengthen the field to the same extent that the armature tends to reduce it; and it may be further strengthened so that the volts lost in the armature and line will be generated in addition, as needed. To effect this result the ordinary shunt winding is first applied; then a series winding is placed beside or on top of this. The series winding has passing through it the entire current of the machine, practically speaking. If this increases when more lamps are applied to the dynamo, the current in the series coil increases; that is to say, its magnetic effect or ampere-turns increases. If the magnetism supplied by these ampere-turns exactly equals that



Winding of a Drum Armature.

(Continued on Page 328.)

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CONTENTS.

TELEPHONE RATES.

The recent discussion at Albany of the Brush bill, framed for the purpose of regulating telephone charges, was made interesting by the appearance of Mr. U. N. Bethell, the general manager of the New York Telephone Company, whose stand in the interests of the telephone people brought to light facts that indicated the making of less profits by them than is generally supposed.

According to the report made by an investigating board, called the Anisworth committee, the Metropolitan Telephone Company were supposed by the supporters of the bill to have made in 1885 a profit of 116 per cent.; in 1886, 147 per cent., and in 1887, 145 per cent. These large profits have been accepted by the public at large as those accrued right along by any telephone company leasing its wires and service to customers in the regular manner.

The utility of a telephone bill containing a power of limitation has, therefore, been advocated on several occasions, and trouble has more than once been brewed to boiling point by the hysterical opponents of trusts, combines, syndicates and large successful business ventures.

The report of the Ainsworth committee was found to contain figures which, according to Mr. Bethell, gave no right to anyone to quote with such extravagance. Many of the most important factors of expense had been disregarded in the assumption of these profits, which were essential to the continued life and activity of the company, and the insertion of these into the total of expenditures brought down the profits, according to Mr. Bethell, from 116, 147 or 145 per cent. to 33 per cent., which in itself was in excess of the true estimate. In fact the figures of the Ainsworth report, when fully examined, indicated a profit made by the New York Metropolitan Telephone Company which did not exceed 10 per cent., being in fact only 9.66 per cent. The expense of the transition from overhead to underground wires, and the fact that the rates had been lowered, was apparently ignored by those favoring the passage of the bill.

The number of subscribers paying $240 a year are few in comparison with those who actually pay less. Of the New York Telephone Company's 18,000 subscribers, only 4,300 pay $240 per annum for telephone service. Of this number 2,500 get all they want on the basis of the message plan. Only 1,800 are therefore left, a total of 10 per cent. paying the regular $240 rate.

Those paying this amount are relieved of a tremendous amount of care by the use of the 'phone,' and so far have been content with the condition of things. If the object of the bill is the relief of the majority it cannot attain that end in the face of these facts, as the majority are not among the $240 customers. There is a great expense entailed in the operation of a large telephone exchange, and at present it seems as if the energy required for its proper guidance at least merits some return without restraint and interference from well meaning, but dangerous outsiders. The pride of this land is its freedom to the capitalist, as well as the laborer. Let commerce and enterprise throw off the shackles that the aspirant after political renown tries to weld around their feet. The church and state have been divorced. Let business and politics follow suit.

Such matters as these ought to be entirely handled by a committee of competent business men of golden integrity and unbiassed judgment.

By Associated Trade and Industrial Press.

Washington, D. C., May 1, 1897. Henry P. Morris, United States Consul at Ghent, has forwarded to the State Department the following report:

The final project for the electric street railways to be constructed in this city is almost ready for publication. For some time past the plans and specifications and the details of the conditions of the franchise to be proposed on the part of the city have been under consideration in the committee of the council. It is now expected that all the particulars will be published for the information of the public and contractors about the end of this month.

As several possible American bidders have made inquiries relative to this project it may be well to mention the details as far as now known. All, however, are only preliminary and may be modified before final approval of the council.

The franchise includes all the lines proposed for the entire city and will be sold to the highest bidder at a fixed annual rental to be paid to the city for a certain term of years, at the expiration of which the city reserves the privilege of purchasing the entire system. The lines to be operated are numerous and will be traced out by the city. The motive power is to be electricity; in the central portion of the city the accumulator; and in the outlying districts, the trolley system.

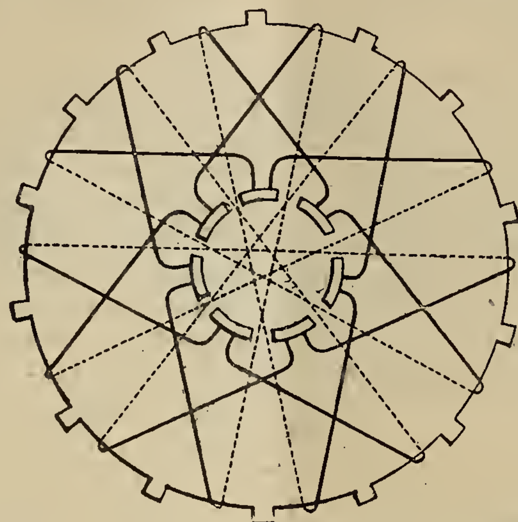
There will be two separate classes for passengers; the fare in the first class fixed at three cents; in the second, two cents.

The working hours of employés are to be 13½ to 14½ hours. The wages of the drivers, conductors and workmen are fixed at 72⅓ 69½ and 58 cents per day respectively.

The details will be fully set forth in the specifications to be published about May 1. B ds will then be received during a period of two months, more or less, and the final award of the franchise will be made on or about July 1. These dates are not yet definitely settled and their mention here is only approximate.

All persons interested should at once address requests for plans and specifications to the Burgomaster of Ghent. At the same time it should be noted that as the time for bidding is comparatively short, any firms anticipating the possibility of obtaining the award would do well to have a specially authorized agent on the spot.

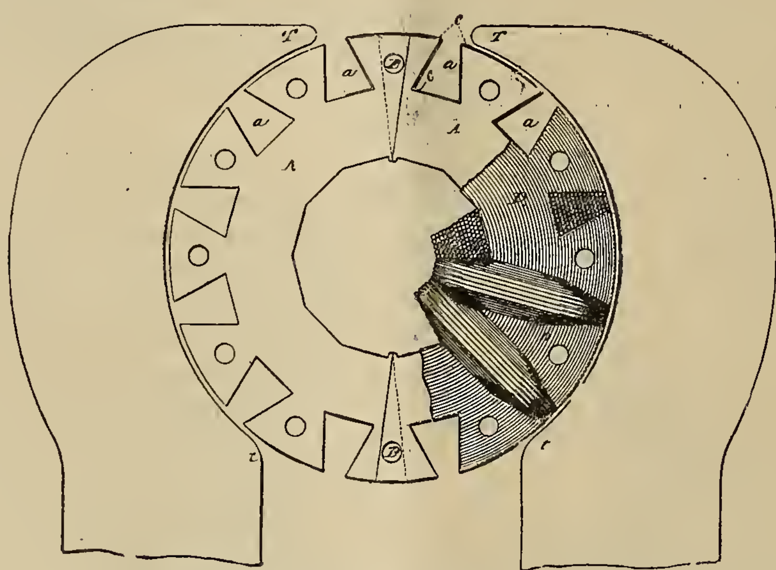
which the armatures neutralize, the machine is compounded for armature reaction. If it supplies sufficient extra magnetism to make up for that lost in the armature and line besides, it is entirely compounded and the dynamo



Principle of Winding a Toothed Drum Armature.

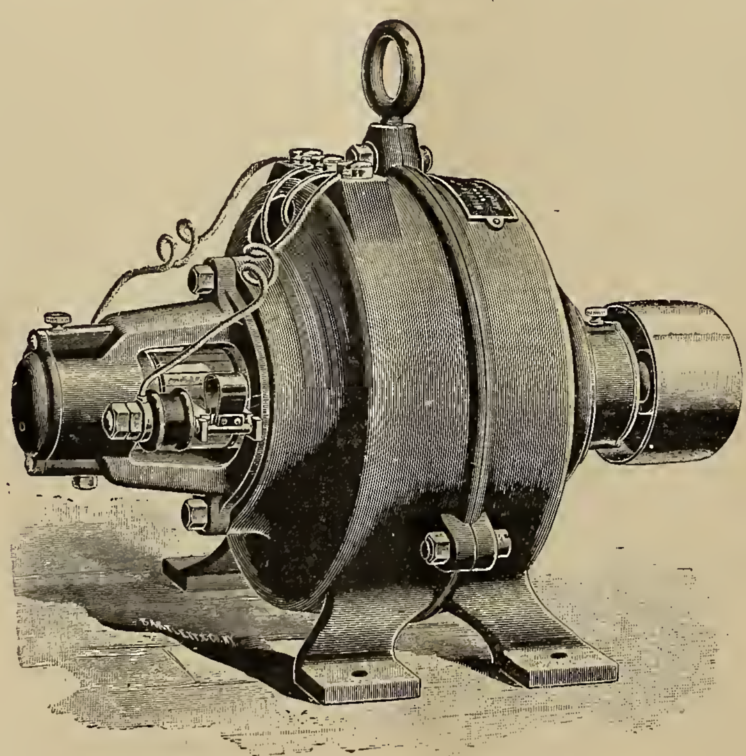
will act automatically with all loads. The drop in the armature, it must be observed, is measured by the product of the current and resistance.

Current × resistance = drop.



Winding of a Toothed Ring Armature.

If the armature has Resistance = .1 ohm,
Current = 100 amperes.
Lost volts in armature = .1 + 100 = 10 volts.



Standard Type of Lundell Motor.

These calculations apply likewise to the line. If the line resistance = .002 ohms,
current = 100 amperes.

Lost volts in line = .002 + 100 = 2 volts.

The field may be cut down by armature reaction 10 per cent. when the armature is carrying 100 amperes; if 110 volts are to be generated, there would be a total loss as follows:

Due to armature reaction,	11	volts,
" " drop,	10	"
" line "	1	"
Total,	23	volts.

As a rough estimate the compound winding would be called upon to compensate for this loss which, as noted above, equals 23 volts.

Types of Dynamos.—The shapes of dynamos and motors

are classified under two general headings. The number of magnetic circuits determine this:

Single magnetic circuits,
Multiple " "

These may be expressed by the names:

Bipolar or two-poled dynamos,
Multipolar or many-poled dynamos.

Multipolar dynamos have poles in pairs, in multiples of two. They are being extensively used at present in all large stations and in many large isolated plants. The arrangement of the poles to complete the magnetic circuit gives rise to many curious shapes.

The ironclad dynamo, with its poles entirely inside, the ordinary horseshoe pattern resting on its keeper or on its poles, and the consequent pole types in which two magnetic circuits feed into one pole, are very interesting to the student. While it is a matter of opinion in many cases as to which is the best, they must be examined from a mechanical as well as an electrical standpoint to appreciate the benefits of each.

When a motor is to be installed certain precautions must be observed in order that no injury from fire can result and no danger from shock exist.

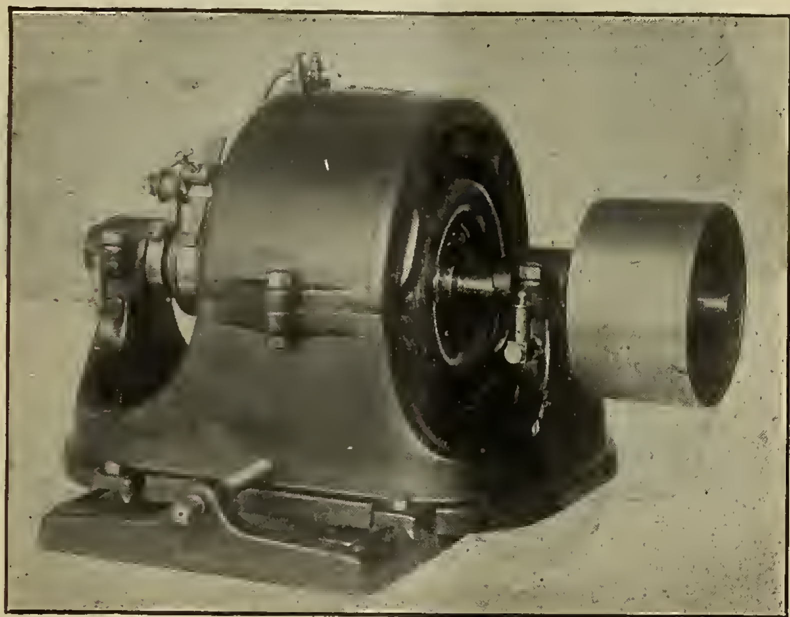
The fire underwriters of every large city impose limitations upon contractors and prevent them from doing careless work. It is usual to mount the motor upon a fireproof foundation and have a large pan underneath to catch the oil drippings. A zinc pan is frequently used for this purpose, the motor being mounted in the centre of it. The starting box must be of slate and have under it a large sheet of asbestos paper. The fuse blocks, devices used for the protection of a line, must be covered to eradicate the dangers of fire from the vaporized metal.

In total the installation of either motor or dynamo must be based upon the fact that the risks from shock and fire are to be entirely removed. A low voltage motor or dynamo does not introduce much danger from mere shock; in this respect, up to about 400 volts the person in charge is secure, but the chances of fire always exist.

A loose hanging connection, a short circuit on the line, a bad ground, etc., may bring about this danger unless regular tests are made to keep the line clear and dynamo insulated. A lightning arrester is a very necessary adjunct to a plant having an outside line. Frequently a station is destroyed by lightning according to report. This may not be true, although lightning is in many cases the orignal cause. Lightning by striking a line, or dynamo through the line, usually sparks across every available gap.

An arc is thus started and continued by the generator itself. It is thus very likely that in many instances the burning is done by the dynamo current, although the original cause—lightning—has long since disappeared. Protectors in many cases fail to protect because there is a certain element in lightning arresters that must be improved, and a peculiar oscillatory nature to the discharge that must be better understood in its many variations before they can be used with certainty in every case.

Both dynamo and motor are protected from an overflow of current by means of a safety fuse or cut-out. This is simply a piece of lead wire inserted in the circuit and of such a size that a flow exceeding the regular amount will melt it and open the line. The danger being over it is then replaced by another piece. Good insulation to either dynamo and motor, good safety devices, in the shape of either cut-outs or lightning arresters and a drip pan to catch the oil, comprise the essential elements of a good installation.



Motor for Heavy Power Work.

ELECTRICITY FROM CARBON WITHOUT HEAT.

(Continued from page 297.)

With this form of cell, it is claimed that as high as 85 per cent. of the energy of the carbon consumed is converted into electrical energy. The following results of tests of the Jacques cell taken from the article referred to and from the Engineering Magazine of July, 1896, may be of interest:

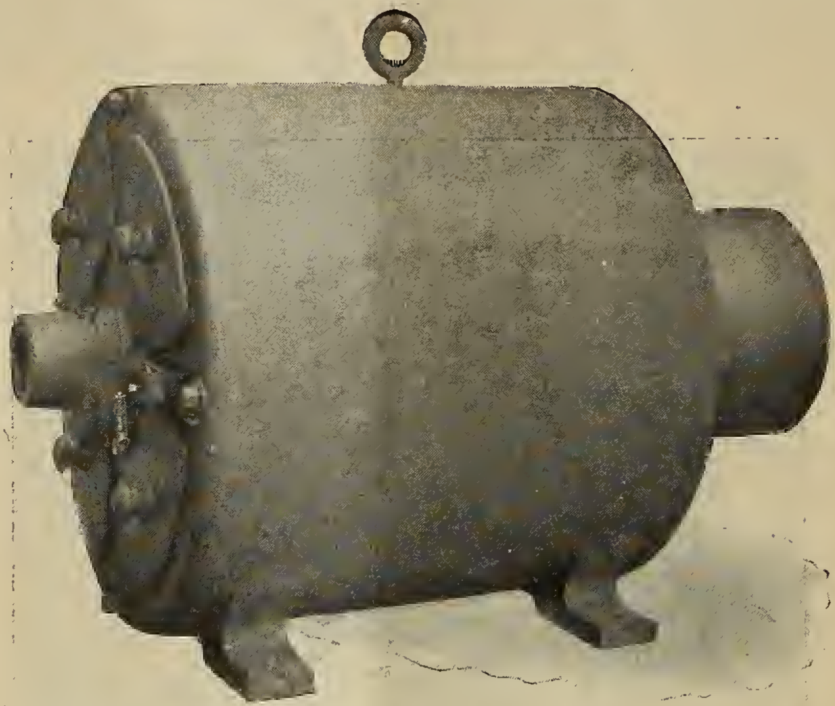
Electricity obtained from one pound of coal (of which 0.4 pound was consumed in the pots and 0.6 was burned on the grate) equalled 1,336 watt hours, or 32 per cent. of that theoretically obtainable.

Another cell reported in the public prints to have been built and operated by Jacques consisted of 100 iron cells, one and one-half inches in diameter and twelve inches deep, which gave an E. M. F. of about 90 volts and 16 amperes, supplying thirty 16 candle-power incandescent lamps for a little over 10 hours. In this experiment it is said that about eight pounds of carbon were consumed in the cells. This, it was stated, gave an efficiency of over 90 per cent., which, of course, did not include the power to operate the air pump and the coal consumed in heating the cells. But my experience with the cells before you leads me to doubt the correctness of these computations.

It has been suggested that carbon consuming batteries would be too bulky and occupy too much space as compared with that occupied by the present central station for a given output. I find, however, that the Edison station at Duane Street, New York, has a capacity of 28,000 electric horse power. The cubical capacity of the building is in round numbers 900,000 cubic feet. The same building crowded with Jacques cells, assuming that they could

perform the work claimed for them, and leaving aside the question of the difficulty of their operation, properly distributed, would have an output of 60,000 H. P. This estimate is necessarily theoretical and based upon statements made by Mr. Jacques, namely, that a furnace containing cells occupying a cubical space of 600 feet have a capacity of 40 electrical H. P. You will thus see that this ratio is in the proportion of 28 to 60 in favor of the battery.

through many attempts and many failures. I believe that we must look at this subject from a different point. In the first place, can we not learn a lesson from nature? We certainly have a most wonderful example of the conversion of potential energy of carbon directly into work in the animal economy which is developed at the expense of the oxidization of the material supplied by the food with an efficiency twice as economical as in the case of the steam engine. One-fifth of the potential energy is



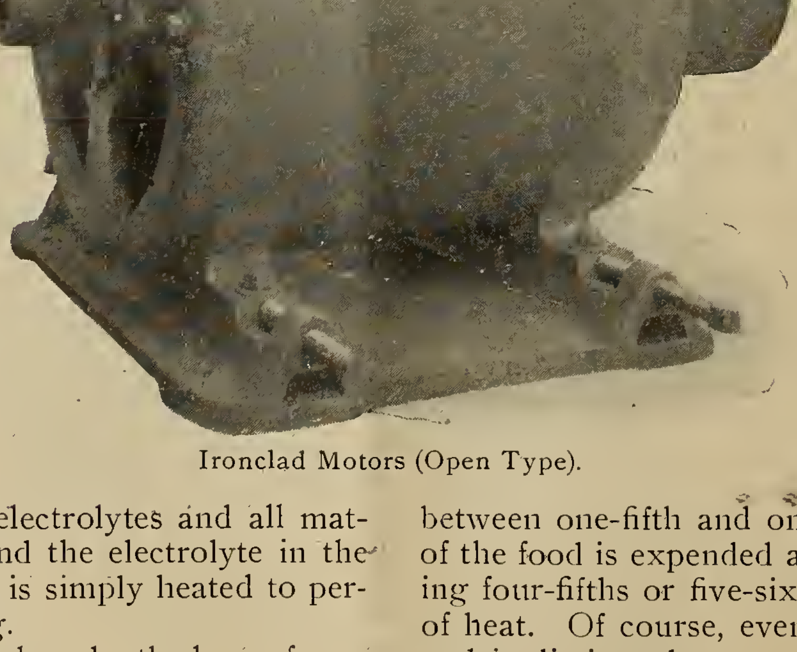
Ironclad Motors (Closed Type).

It has been stated that the E. M. F. of the carbon consuming cells is so low that they would be of no practical value. I think our experience with the storage battery in central stations refutes this idea; at least, for potentials up to 250 volts and by means of rotary transformers the current can, if necessary, be converted into any form and pressure.

These cells, if correct in theory, can be heated without infringing on the second law of thermo-dynamics, as the law does not apply so long as the oxidization of the carbon itself does not produce but electricity. For, as we

converted into work; four-fifths is converted into heat. But we must remember that the human body must be able to exist in the Arctic regions as well as in the tropics, that the engine room must always be kept warm, and to insure this average in all parts of the earth and under all conditions the four-fifths of what apparently is waste energy is necessary to maintain the race.

A day's work of muscular toil is laid down by the authorities at about 1,084,950 foot pounds. The normal daily expenditure in heat cannot be so readily determined; it is estimated at 6,148,000 foot pounds; that is,



Ironclad Motors (Open Type).

have said, there is heat in the electrolytes and all matter down to an absolute zero, and the electrolyte in the practical operation of these cells is simply heated to permit the chemical affinities acting.

We are governed here, as elsewhere by the laws of evolution, and I think that this question will be solved only

between one-fifth and one-sixth of the potential energy of the food is expended as mechanical labor, the remaining four-fifths or five-sixths leaves the body in the form of heat. Of course, eventually the work goes into heat and is dissipated.

In the human economy the oxygen of the air is taken

up by the blood in the lungs. It is carried through the arteries and attacks the tissues, giving up its oxygen and so oxidizing them and thus producing heat; and when the work is done the equivalent of the heat disappears as work, and when the work is not done, the temperature rises, perspiration and evaporation take place, and the temperature is kept at its normal condition through this safety valve. In other words, expressed electrically, there is local action as in a battery. I am aware that the question of the cause of muscular contraction is in dispute, but it is generally admitted that the muscular force must be derived from mechanical energy.*

*Proceedings of Royal Society, March 14, 1895.

POLICE TELEGRAPHERS MEET.

The Executive Committee of the International Association of Police and Fire Telegraph Superintendents met Monday afternoon, May 17th, at the Clarendon Hotel, to arrange a place for the next annual meeting of the association. This association was organized last September, Frank Mason, superintendent in this city of police telegraph, being elected president. Those who attended the meeting included William Y. Ellett, of Elmira; John W. Aydon of Wilmington, Del.; F. F. Zuleff, of Paterson; Brown F. Flanders, of Boston; H. F. Blackwell, of Brooklyn; S. L. Wheeler, of Springfield, Mass.; William Brophy, Boston; Adam Bosch, Newark, N. J.; Fred Pearce, New York; R. W. Gordon, New York; W. L. Candee, New York; F. C. Mason, Brooklyn, N. Y.

President Mason welcomed the visitors, and the business on hand was disposed of in short order. It was decided to accept the invitation to visit Nashville, Tenn., for the next convention; and Tuesday, September 8, was decided upon, this being the date of the "Old Time Telegraphers and the U. S. Military Telegraphers'" meeting at the same place. The report of Treasurer Bosch shows the association to be in a good financial condition. The association is steadily growing in numbers. J. W. Aydon of Wilmington, Del., was elected a member of the Executive Committee.

F. C. Mason, Pres.

NEW IRON-CLAD MOTORS.

The C. & C. Electric Co., 143 Liberty street, have placed upon the market some new designs of iron-clad motors. The frames are made of soft steel with inward-pointing poles; at each end is a protective circular plate upon which the bearing and rocker arm is mounted. The magnetic circuit consists of four poles wound with easily removable coils that are interchangeable. The armature is of the drum type made up in the conventional manner of laminæ of soft iron, each layer insulated from the other to avoid the possibility of Foucault currents flowing. The conductors are laid in slots and are securely bound.

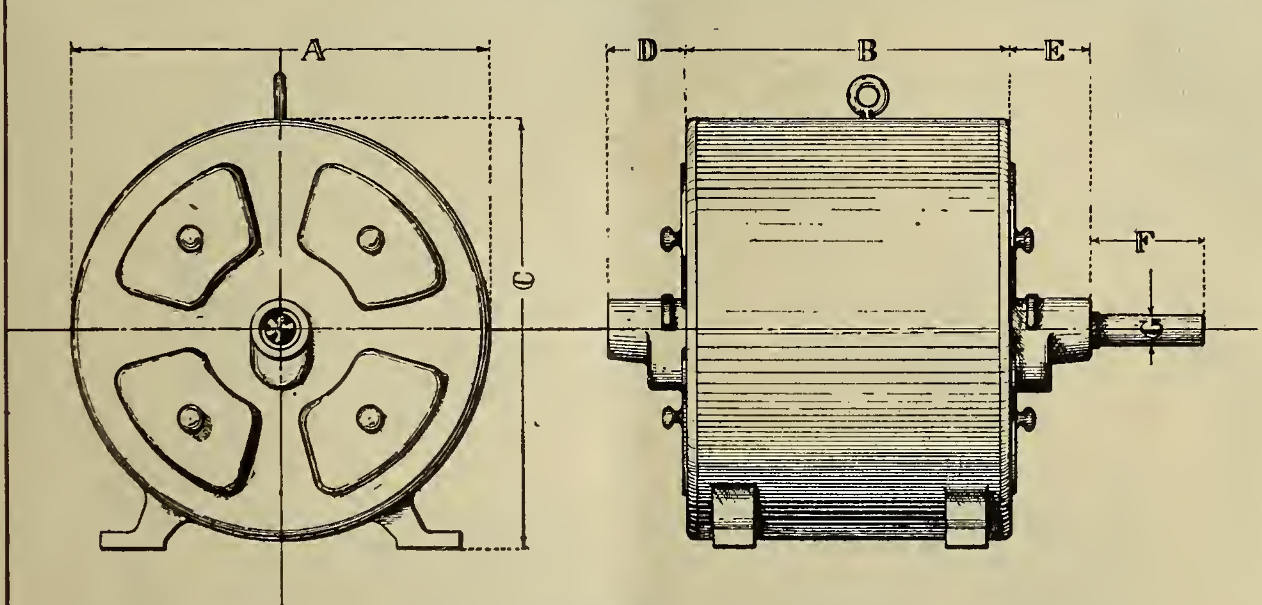
The commutator is of large cross-section and well built; the brush-holders of the "reaction" type, giving the brushes an opportunity of bearing upon the commutator with a flexible and even pressure.

The bearings are self-oiling and will run for weeks without attention.

The shaft is of the best steel, being strong, durable and elastic. The machine can be readily used for direct connection to gears or other apparatus. It can be used as a ceiling motor or mounted on an A frame at any angle. The steel shell five-eighths of an inch thick can be used for tapping or drilling, to make the motor form part of the framework or driving power.

The efficiency varies from 85 to 92 per cent., according to the size of motor.

The many advantages of these motors have made them highly acceptable to the trade and to their most desirable adjunct, the consumer.



THE C & C ELECTRIC CO.

DIMENSIONS OF IRON CLAD MOTORS

Horse Power	A	B	C	D	E	F	G	Speed
15	25 3/4	25	26	4 5/8	4 5/8	4 3/8	1 15/16	850
20	28	25 1/4	28 1/4	4 7/8	4 7/8	7 1/16	1 15/16	800
25	29 1/2	26 1/8	29 3/4	5 1/8	5 1/8	8 5/16	2 5/16	750
30	33	27 3/8	33 1/4	5 7/8	5 7/8	9 1/16	2 5/16	700
40	36 1/4	27 3/4	36 1/2	6 7/8	6 7/8	9 1/2	2 11/16	700

Dec. 15. 96 3 K 8

Chicago, Ill.—The North Shore Inter-Urban Railway Co. has been incorporated with a capital stock of $40,000. The new line will be operated by electricity, and will connect the northern suburbs, Waukegan and Highland Park.

Galion, Ohio.—The Electric Signal Clock Co. has been incorporated with a capital stock of $25,000.

Elkin, N. C.—The Western North Carolina & Virginia Telephone Co. has been organized to construct telephone systems, etc.

Electrical Age

Vestibule of Pulitzer Building, N. Y.—Model of Dome Corresponding with Dome Top of Building.

A MINIATURE DOME OF ELECTRIC LIGHTS.

In the lobby of the Pulitzer Building, for the purpose of lighting up the hall and stairway, may be found a miniature dome of electric lights. It is a perfect duplicate of the larger dome on the World Building, and is gazed upon with interest and curiosity by the many strangers always flocking into the place.

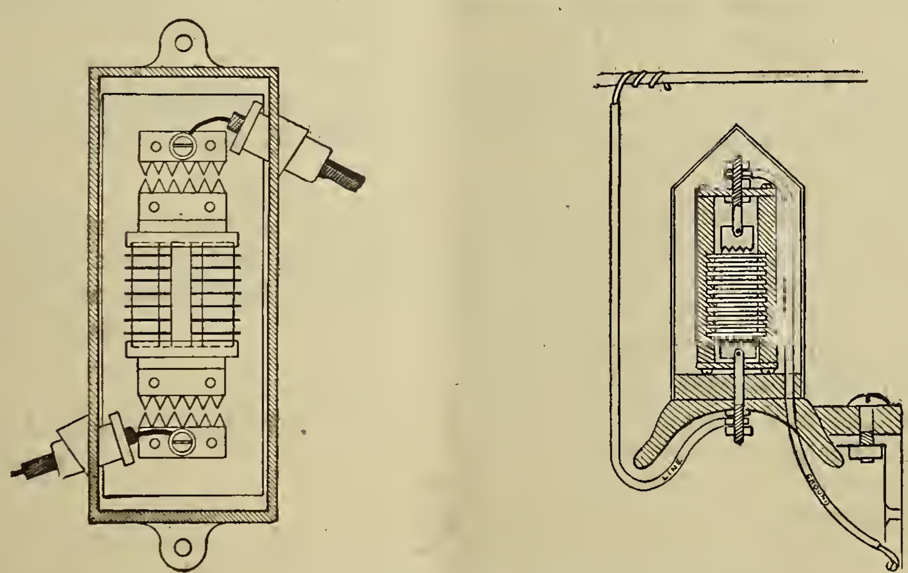
The meridians of light are built up of small incandescent lamps of two-candle power apiece. A total of ninety-six are used for this purpose, the top of the dome being crowned with a sixteen-candle power lamp.

The little dome, which is about four feet in diameter, not only illuminates the vestibule and lobby, but provides quite an æsthetic feature of a most noteworthy character. The wires are laid in iron conduit, thus making the dome fireproof and electrically safe from injury. The neatness of the work, and its success from the start, will probably make the lighting a permanent feature.

UNIVERSAL NON-ARCING LIGHTNING ARRESTER.

This lightning arrester is manufactured by the Universal Electric Co., 126 Liberty street, New York. It can be used either for car service or station work. For car service it is designed to meet with vibration and remain unaffected. The lightning discharges itself in this type of arrester by jumping the air-gap to the alternate layers of metal and mica to the ground via the second air-gap. An arc is impossible with this construction, as the current loses its power of supporting an arc.

It is a reliable arrester for long-distance lines. The lack of care it requires is astonishing, being automatic, without fuses, magnets or pendants. In general the construction is as follows: in a cylindrical block, forming a column between two toothed plates, are a series of layers of mica and metal; each is isolated from the other and the whole mounted upon a porcelain base and protected by a brass cover. An iron bracket attaches it to the pole or support. The choice of paths is always in favor of the arrester, and the line is saved from the discharge. The general construction embodying these principles is delineated in the sketches above.



Sections of Universal Non-Arcing Lightning Arrester.

Two visitors called upon the Electrical Age this week. Mr. Thos. J. Fay, E.E., New York manager of Crocker & Wheeler Electric Co., and Sydney C. Dare, E.E., of Bahia, Brazil, representing railroad interests. He is looking up the subject in the United States.

Doylestown, Pa.—Work will shortly commence on the new trolley extension to Willow Grove.

THE SYNCHRONOGRAPH.*

A New Method of Rapidly Transmitting Intelligence by the Alternating Current.

BY ALBERT CUSHING CREHORE AND GEORGE OWEN SQUIER.

(Continued from page 317.)

Instead of using insulating papers situated upon a single circumference of the wheel, two or more similar lines may be used either upon different circumferences of the same wheel or upon different wheels, and separate brushes ride upon the different circumferences. The same freqencies of current may be employed to operate all lines of brushes, or currents having different frequencies may be employed upon the separate circuits, all of which use the same line for transmission. These arrangements make it possible either to send different messages simultaneously over the same line employing a single cycle as the unit, or to send a message employing different frequencies to represent the different characters of a code, or many combinations of these.

The employment of alternating waves of different frequencies upon the same line by the method shown does not have the same objections which exist when a constant electromotive force is used. Since the circuit is by this system always interrupted when the current is naturally zero, the frequency employed is within certain limits a matter of indifference, as the line is in the same condition whether a long or short wave is used.

It is seen by this simple method of operating upon the alternating current, according to the above principles, there is complete control of the individual semi-waves of the current, which may be changing direction thousands of times in a second, far beyond the range of possible manipulation by hand. In other words it is easy to obtain a record of any pre-selected order or succession of semi-waves desired. It is evident that it is as important to be able to control the semi-waves retained, as it is those suppressed, since they are of equal value in interpretation. Furthermore there is great utility in being able to control *each single semi-wave* of the current, for this permits the maximum speed of transmission of signals with a given frequency.

A transmitter which operates upon the current at intervals comparable with the duration of a semi-wave, but which does *not* act in synchronism with the current, would necessarily make and break the circuit at times when the current is not naturally zero. If this were done there would not only be sparking, but in addition, the current would be interfered with in such a manner as to make it probable that the record received could not be interpreted; for the current at each make would follow such a curve as that shown in Fig. 3.

PRINCIPLES OF RECEIVERS.

As used throughout this paper, the term "receiver" will be understood to mean that mechanism which uses the energy transmitted over an electric circuit and transforms it so as to make a permanent record which may be translated into intelligence. The term receiver is here restricted to mean instruments which make a permanent record, since this is a necessary condition for the rapid transmission of intelligence, with which we are at present concerned. All receivers require a certain amount of power to operate them, and the power required affords one basis for their classification.

Another method divides receivers into two classes, those which have inertia in the moving parts and those which have none. There is no fundamental reason why any one of these general classes should contain all of the most rapid receivers. Any of the above classes might include receivers which are very rapid. If, for instance, a receiver has inertia in the moving parts, for rapidity the amount of inertia should be small, and its natural period high, or a large amount of energy would be required to operate it. If a receiver has no inertia in the recording mechanism, then the possible rapidity is limited by the power supplied.

In deciding upon the relative merits of receivers from the point of view of rapidity, the cost of the power required offers no reason why considerable amounts of power should not be transmitted over certain land lines for purposes of telegraphy. Using a receiver which possesses much inertia in its moving parts, it does not follow that even though considerable energy reaches the receiver over the line, that it will be rapid in its action.

The Wheatstone receiver may be taken as representative of a type of receivers possessing inertia in the moving parts, which has come into successful operation. The record is made in this instrument by a small wheel which vibrates back and forth between an ink surface and the recording tape. The energy which is essential is that required to move this little wheel and the parts connected with it back and forth. Although considerable energy may possibly be sent over the line and be expended in the instrument, it seems impossible to concentrate more than a certain part of it upon the moving mechanism. This suggests two methods of improving the speed of the system; either to increase the power received by the moving parts, or diminish their moment of inertia. One factor which limits the Wheatstone type of receiver is that the moving parts are required to do the work of making the record. This is not a necessity, since light may be employed as the agent to make the record under the control of the moving parts, as is evidently accomplished in a form of galvanometer having a very minute needle with mirror attached, the slightest motion of which is greatly magnified by the reflected beam of light.

As a type of instrument having no inertia in the recording mechanism, may be mentioned the various forms of chemical receivers acting by electrolysis. This type of receivers possesses many advantages, perhaps chief among which is the fact that a large part of the energy received is brought directly to bear upon making the record. Another feature is the simplicity of the essential mechanism involved, as no intermediate steps are employed after the impulse is received from the line before the record is made. These qualities alone imply rapidity, and this receiver is one of the most rapid known. The limit of rapidity with this receiver is the power received from the line. If the potential between the terminals of the receiver is increased, the time required to make a given record is correspondingly reduced. The use of the alternating current permits of greater potentials being realized in the receiver with less disturbing influence from the line than would be the case if a constant direct electromotive force was employed.

A new type of receiver having no inertia in the recording mechanism was used in developing the transmitter described in these experiments. This instrument has already proved of value as a chronograph for the measurement of minute intervals of time, and for the study of any kind of variable electric currents. Although its application as a practical telephone receiver is not at present advocated, yet the realization of a *massless* receiver upon different lines merits description. This receiver is based upon Faraday's discovery of a direct relation between light and electricity.

This discovery was, that if a beam of polarized light is passed through some substance in the direction of the lines of magnetization within that substance, there is a rotation of the plane of polarization in a direction which is the same as the direction of the current required to produce such a magnetic field. The direction of rotation is unaltered, therefore, whether the light beam advances in the same or in the opposite direction to the magnetization, so that a beam reflected back and forth through the substance several times, has its rotation increased by equal amounts each time. If the direction of the ray of light is at right angles to the lines of magnetization, there is no rotation produced. The amount of this rotation has been investigated by Verdet, who announced laws by which it may be expressed. They are summed up in the following statement:

"The rotation of the plane of polarization for monochromatic light is in any given substance proportional to the difference in magnetic potential between the points of entrance and emergence of the ray:" that is, it is equal to a constant times this difference of potential and is expressed by the formula

$$\theta = v\, V,$$

where θ = angle of rotation, V = difference in magnetic potential, and v for a given wave-length is constant in any given substance and is known as Verdet's constant.

(To be Continued.)

NATIONAL ASSOCIATION STATIONARY ENGINEERS.

Oxford Association No. 53, N. A. S. E., was duly organized by State Deputy W. T. Wheeler, at Oxford, Chenango Co., N. Y., May 15, 1897. This promises to be an association that will redound great credit to the national body, as its members are intelligent and enthusiastic. They started with thirteen charter members, and before long will have the better class of engineers in Oxford, Norwich and Chenango Forks enrolled on its membership list.

The following officers were elected and installed:

President, Asa P. Hyde; Vice-president, R. B. Stratton; Recording and Corresponding Secretary, A. E. Halbert, Norwich, N. Y.; Financial Secretary and Treasurer, A. S. Lewis; Conductor, Seymour Fluning; Doorkeeper, W. E. Dunn; Trustees, W. E. Skinner, J. L. Brown, C. L. Webb.

W. T. Wheeler, State Dep-Pres., 120 Broadway, N. Y

NEW TELEPHONE COMPANIES.

Natchez, Miss.—The Natchez Telephone Construction Co. has been incorporated by A. G. Campbell, W. D. Stewart, J. C. French, J. A. Clinton and others; for the purpose of constructing telegraph lines, etc. Capital stock, $25,000.

Dublin, Ga.—The Southern Union Telephone Co. has been organized with William Pritchett, president. The company will have control of the entire system between Dublin and Sandersville, and such other lines as it shall decide to build.

Saltillo, Tenn.—The Saltillo & Decaturville Telephone Co. has been incorporated.

Spartansburg, S. C.—The Spartansburg Telephone Co., incorporated by Albert H. Twitchell, D. E. Converse, John H. Montgomery, H. E. Heinitsh and others. Capital stock, $10,000.

Port Arthur, Tex.—The Port Arthur Telephone Electric Company has been incorporated by R. H. Woodworth, F. Dumont Smith and George E. Blaine. Capital stock, $50,000.

Georgetown, S. C.—The Waverly Telegraph & Telephone Co. has been incorporated by Louis Breslauer, L. C. Lachicotte, F. W. Lachicotte and St. J. M. Lachicotte; to build and operate telegraph and telephone lines. Capital stock, $1,000.

Maryville, Mo.—The Hanamo Telephone Co. has been incorporated by E. H. Ralston, J. C. Donnell, H. E. Ralston and others. Capital stock, $10.000.

Graham, Tex.—The Graham, South Bend & Eliasville Telephone Co. has been incorporated by W. L. Donnell, of Eliasville, O. A. McBrayer, W. H. Ardis, R. G. Graham and R. F. Arnold.

TELEPHONE NOTES.

Sweetwater, Tenn.—The Sweetwater Telephone & Improvement Co. has recently been chartered, and is now operating an exchange.

New York, N. Y.—The New York Telephone Co. held annual meeting of stockholders recently, and elected the following directors: Charles E. Cutler, Joseph P. Davis, John H. Cahill, Thos. T. Eckert, William H. Forbes, George J. Gould, Edward J. Hall, John E. Hudson, and John Jameson.

Stillwater, Minn.—The American Telephone & Telegraph Co. has been granted right to operate lines in this city.

Webster, N. C.—The Webster & Dillsboro Telephone Co. is extending its telephone lines.

NEW CORPORATIONS.

Albany, N. Y.—The Buffalo & Depew Railway Co. has been incorporated by Herbert P. Bissell, Wm. B. Cutter; to build an electric road from Lancaster to Buffalo, a distance of eight miles. Capital stock, $100,000.

New York, N. Y.—The Manufacturers and Inventors Electric Co. has been incorporated by Thomas J. Smith, Edward K. Curtis, and William J. Cordo. Capital stock, $5,000.

Bad Axe, Mich.—Bad Axe Electric Light and Power Co. has been incorporated, with a capital stock of $10,000.

Palestine, Tex.—The Citizens' Electric Light and Power Co. composed of A. C. Green, Dr. J. M. Cooley, Lee Robinson, O. C. Kennedy and others, have asked for franchise for electric light plant.

Niagara Falls, N. Y.—The Lundy's Lane Electric Railway Co. has been incorporated to build a line from Victoria Park to Drummondsville.

San Francisco, Cal.—The Bay City Electric Light and Power Co. has been incorporated by Louis De Rome, H. G. Knowles, G. W. West, Frederick Mueller and William F. Gibson. Capital stock, $75,000.

Binghamton, N. Y.—The Savona Valley and Lake Keuka Electric Railway Co. has been incorporated. The road will cost about $200,000, and will be completed by September 1.

Bowdle, S. D.—The Bowdle Electric Light Co. has been incorporated by H. D. Baillyt, W. W. Brant, A. F. LeClaire and S. L. Yeaton. Capital stock, $5,000.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

Jacksonville, Alabama,
May 5, 1897.

Electrical Age Pub. Co.

Dear Sirs: You will please confer a favor on me by giving me some information as to best methods of becoming a mechanical and electrical engineer.

I desire to know what is the difference between an "electrician" and an "electrical engineer?" And which is the best method of obtaining a thorough knowledge in E. & M. E. course—by working in shops or in technical college? or work in shops and finish in college? or start in college and finish in shops? Also inform me which is the best college in the United States in this branch of science, and which are the best shops to learn in.

I am desirous of learning, and want to know the best method to pursue.

Doubt has arisen as to which is best, and I consider I am making search in the proper direction for the information desired. Thanking you in anticipation of your interest in my behalf, and hoping to hear from you at your convenience,

I am yours truly,
Sam. S. Nesbitt.

(A.)—An electrical engineer must possess a thorough knowledge of his own science from both a theoretical and practical standpoint before he really deserves the title. Your time will be fully occupied in becoming an electrical engineer if spent conscientiously, that is, in studying modern practice in the engine-room, power and lighting station; learning the principles of the dynamo, its construction and care, etc., etc.

The word "mechanician" bears a relation to the name mechanical engineer similar to that which the expression "electrician" bears to the term electrical engineer. It is a general name of indefinite meaning in the profession itself, but commonly accepted by the outside world as the proper title of one engaged in electrical pursuits of almost any nature or description from a bell-hanger to that of Nikola Tesla.

A technical college is the best to go to; then the shop, station or factory. Or a technical school education, a good college course, and then the shop, etc.

The course in Columbia University, New York, is among the best. The General Electric Co.'s shops will supply you with lots of experience.

The secret of success lies in persistent labor.

(Q.)—USE OF CUT-OUTS.

May 2, 1897.

Electrical Age Publishing Co.,

Dear sirs: When a cut-out is used, is it always fused according to the number of lights used, or is that decided upon by the engineer; that is, the fusing point?

Is it right to use fuses that are heavier than the lamp current? Under what conditions is a cut-out deemed indispensable? The above questions occurred to me the other day while wiring. They may be of service to others; at least, the answers will.

Yours respectfully,
Robert Cushing.

(A.)—The cut-out should be fused in accordance with the number of lights on the line. The engineer should employ fuses that will blow when the line is overloaded, unless a branch supplies a motor, etc.; then the fuse used is correspondingly heavier.

A fuse block is required whenever two wires of different sizes meet.

FRED. PEARCE, No. 79 John street, New York, the well-known manufacturing electrician, sails for Europe May 29.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued January 12, 1897.

574,885. Controller for Electric Motors. Harry P. Davis, Pittsburg, Pa. Filed December 3, 1895.

574,889. Electric Cigar Lighter. John W. Dawson, Louisville, Ky. Filed August 17, 1895.

574,896. Combined Rheostat and Reversing Switch. Jonathan P. B. Fiske and Charles P. Smith, Alliance, Ohio. Filed March 18, 1895.

574,901. Telephone. Claude C. Gould, Philadelphia, Pa. Filed April 29, 1895.

574,903. Electric Meter. Johannes Hessberger, Niedersedlitz, Germany. Filed August 10, 1895.

574,905. Electric Arc Lamp. Ralph O. Hood, Danvers, Mass. Filed July 6, 1896.

574,914. Means for Adjusting Compound-Wound Dynamos. Benjamin G. Lamme, Pittsburg, Pa. Filed December 28, 1893.

574,922. Electric Calendar Clock. George W. MacKenzie, Beaver, Pa. Filed December 28, 1895.

574,926. Overhead Electrical Knife Switch. Joseph Menchen, Kansas City, Mo. Filed February 25, 1896.

574,953. Electrical Signal System. Robert Skeen, Madison, Ill. Filed March 4, 1895.

574,954. Electric Signal. Robert Skeen, Madison, Ill. Filed May 11, 1895.

574,965. Vacuum Dispatch System. James A. Watson, Washington, D. C. Filed February 18, 1893.

574,978. System of Lightning Protection for Electric Circuits. Alexander J. Wurts, Pittsburg, Pa. Filed July 19, 1893.

574,979. Device for Protecting Electric Circuits. Alexander J. Wurts, Pittsburg, Pa. Filed October 2, 1895.

574,994. Printing Telegraph. Bernhard Hoffmann, Paris, France. Filed July 17, 1895. Patented in France December 1, 1894.

575,002. Illuminant for Incandescent Lamps. Alexander de Lodyguine, Pittsburg, Pa. Filed January 4, 1893.

575,045. Electric Valve Apparatus. John V. Stout, Easton, Pa. Filed June 7, 1892.

575,047. Electric Quick-break Switch. Arakelyan H. Armen, Philadelphia, Pa. Filed March 30, 1896.

575,053. Electric Railway. Leon Dion, Natick, Mass. Filed December 30, 1895.

575,054. Electrical Propulsion for Railway Cars. Leon Dion, Natick, Mass. Filed February 27, 1896.

575,059. Bicycle Electric Bell. Herbert B. Ewbank, Jr., Baltimore, Md. Filed May 18, 1896.

575,072. Electrically Operated Piano Attachment. Ernest J. Simpkins, Toledo, Ohio. Filed December 26, 1895.

575,080. Trolley Head for Electric Cars. William S. Troutwine, Indianapolis, Ind. Filed May 22, 1896.

575,099. Trolley Stand. John E. Bishop, Indianapolis, Ind. Filed August 22, 1896.

575,116. Direct Current Dynamo-electric Machine. Maurice Hutin and Maurice Leblanc, Paris, France. Filed February 12, 1894. Patented in France June 29, 1893, and in England December 4, 1893.

575,131. Signaling Appliance for Telephone Switchboards. Charles E. Scribner, Chicago, Ill. Filed November 4, 1895.

575,156. Electric Bell. John W. Holdsworth, St. Louis, Mo. Filed April 9, 1896.

575,170. Electric Conductor. Herbert T. Richards, Brooklyn, N. Y. Filed November 20, 1896.

575,186. Telephone System. John H. Weckel, Breakabeen, N. Y. Filed March 7, 1896.

575,210. Dynamo-electric Machine. George L. Campbell, Kinsman, Ohio. Filed October 8, 1895.

575,231. Static Generator. Augustus J. Gawne, Sandusky, Ohio. Filed October 10, 1896.

575,235. Electric Current Regulator. William Hawker, Windsor Mills, Canada. Filed September 25, 1896.

575,303. Electric Railway. George W. C. Lomb, Birmingham, Ala. Filed February 18, 1895.

575,314. Electric Locomotive. William L. Silvey, Dayton, Ohio. Filed November 7, 1895.

574,280 Signaling Device for Telephone Exchanges. Charles E. Scribner, Chicago, and Frank R. McBerty, Downer's Grove, Ill. Filed Nov. 27, 1894.

574,281. Plug for Telephone Switchboards. Charles E. Scribner, Chicago, and Frank R. McBerty, Downer's Grove, Ill. Filed May 11, 1894; renewed June 19, 1896.

574,301. Electric Lamp Base. Waldo C. Bryant, Bridgeport, Conn. Filed October 31, 1896.

574,320. Electric Water-wheel Governor, Arthur Giesler, Dayton, Ohio. Filed April 20, 1896.

574,322. Electrode for Secondary Voltaic Batteries. George A. Grindle, Prestwick, England. Filed October 13, 1896.

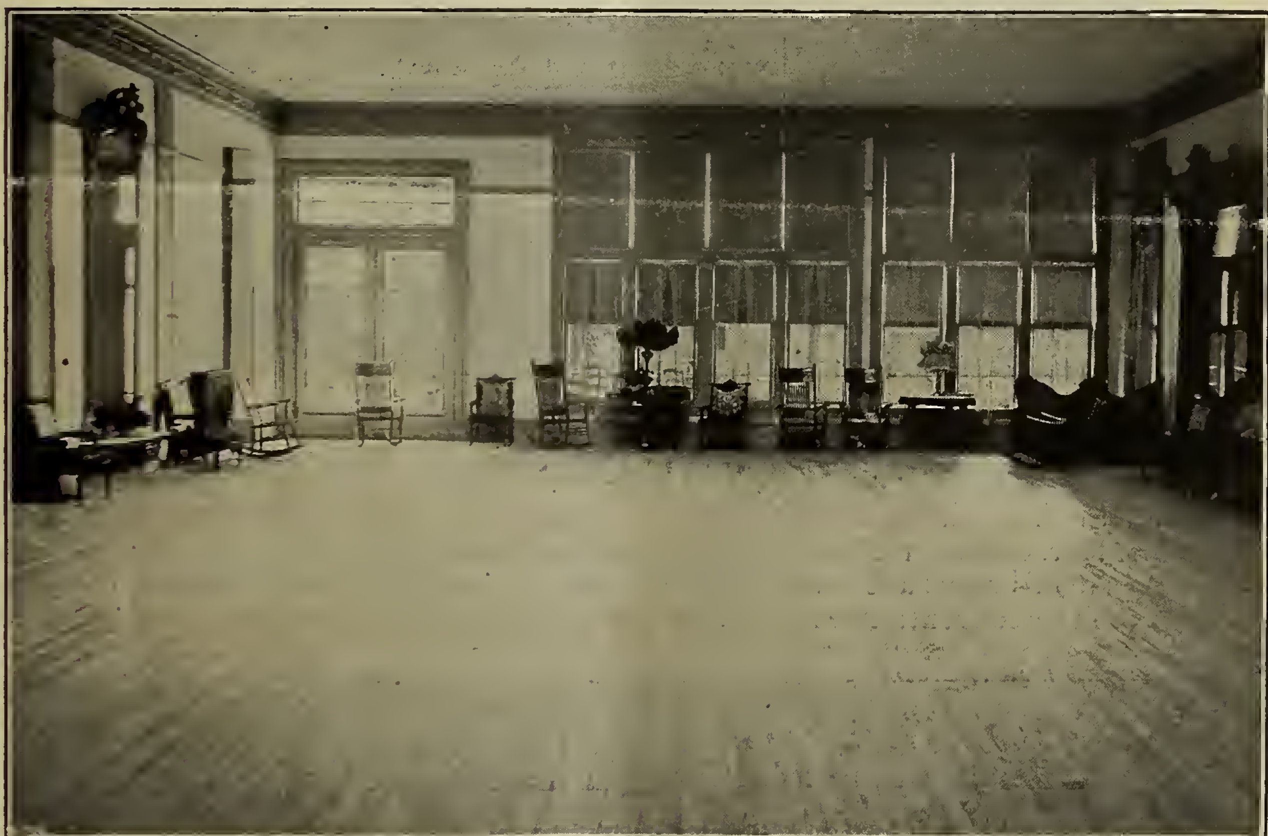
574,327. Electrical Annunciator. Robert L. Hunter and Henry B. Higgins, Minneapolis, Minn. Filed November 19, 1895.

574,333. Mechanism for Locating and Determining Defects in Rail Bonding. Pierre O. Keilhotz, Baltimore, Md. Filed February 29, 1896.

The Electrical Age.

VOL. XIX., No. 22. NEW YORK, MAY 29, 1897. WHOLE No. 524

International Hotel.



Convention Hall.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

One of the great and most important electrical events of the year is close at hand. The National Electric Light Association, which numbers amongst its members the majority of best known electrical engineers in the United States, will enjoy a visit to Niagara Falls, the seat of the approaching convention to be held June 8, 9 and 10.

The occasion is one that has been eagerly waited for by many members of the Association. It has always provided an opportunity for them to meet for purposes of business instruction and pleasure, and has never failed to leave the pleasantest of recollections in the hearts of those in attendance.

The International Hotel has been chosen as the headquarters and convention hall, and this establishment will be in readiness for the guests at the appointed time.

Special Train Arrangement :

The arrangement for a special train has been a somewhat perplexing question, owing to the desire on the part of the association that members should enjoy the best possible service at the lowest possible rate. After long and continuous negotiations, a most satisfactory arrangement has been made with the West Shore Railroad to run a special train of vestibuled parlor, library and dining cars, leaving New York (foot Forty-second street, North River, 10:15 A. M. and foot Franklin street 10 A. M., Monday, June 7. Tickets to return via West Shore R. R. or New York Central and Hudson River R. R., thus enabling the delegates who take this train to enjoy the view of both sides of the Hudson if they so desire.

The daylight run was decided upon owing to an almost unanimous request on the part of the members, on account of the large number of ladies who propose honoring the N. E. L. A. with their presence.

The special train has always been one of the features of the conventions, and this one promises to excel any of

its predecessors. Everything has been done for the comfort and pleasure of the passengers, even to providing a souvenir for the ladies.

Price of tickets to Niagara Falls, including parlor-car seat, $10. For ticket and parlor-car accommodations, apply to C. O. Baker, Jr., 136 Liberty street, New York.

The International Hotel at Niagara Falls is unquestionably the best equipped for the reception of the N. E. L. A. delegates. It provides all the necessaries of a first-class hotel and is managed by Mr. Horace Fox, a man of large experience. The gentler sex, such as may have accompanied their husbands or brothers to the convention, will find the International Hotel as far as their interests are concerned presided over by Mrs. Fox. From the rooms of the hotel, which is the nearest of any to the Falls, may be seen the Rapids, the islands of Niagara and the American Falls. The International is built of fire-proof material, is lit by electricity and provides in every way for the comfort and satisfaction of the guests.

The regular rates of this hotel are from $3.00 to $5.00 per day, or $17.50 and upwards per week. Those desiring special rooms to be held in advance must write at once.

Inside the Veranda.

The Niagara Falls Park and River Railway on the Canadian side will give a magnificent view of the mighty Falls. The fascinating sight of the leaping waters, the wild rapids and sinuous whirlpool below will never be forgotten by those making their first visit. The American and Horseshoe Falls, Dufferin Islands and Old Chippewa must not be left unseen. Or Queenston Heights,

The Main Entrance.

Brock's Monument and the grand view from the Heights with Toronto outlined beneath.

Lastly, for this brief sketch can but faintly suggest the beauties of the Falls, a ride in the steamer the Maid of the Mist to the foot of the cataract; then indeed

" The Genius of the place
With crystal welcome holds you fast;
The torrent wilder yet streams past!"

The order of proceedings have been gathered together under the following head :—

N. Y. ; A. Markle, Hazleton, Pa. ; W. W. Carnes' Memphis, Tenn. ; W. R. Gardner, Pittsfield, Mass. ; G. A. Redman, Rochester, N. Y. ; H. A. Wagner, St. Louis, Mo. ; John A. Seely, New York, N. Y.; A. J. De Camp, Philadelphia, Pa. ; A. M. Young, Waterbury, Conn.

TUESDAY, JUNE 8TH, 1897.

Meeting of the Executive Committee, at 9 a.m., Secretary's Office, International Hotel.

Morning Session, 10-30 o'clock, Convention Hall, Inter-

Dining Room.

TWENTIETH CONVENTION PROGRAMME OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION, HELD AT NIAGARA FALLS, JUNE 8, 9, 10, 1897.

Officers :—President, Frederic Nicholls, Toronto, Ont.; First Vice-President, Henry Clay, Philadelphia, Pa. ; Second Vice-President, J. J. Burleigh, Camden, N. J. ;

national Hotel. Address, President Frederic Nicholls.

Report—Committee on Standard Candle-Power of Incandescent Lamps, Louis Bell, Chairman.

Report—Committee on Data, H. M. Swetland, Chairman.

Report—Committee on Rules for Safe Wiring, William

Ladies Parlor.

Secretary and Treasurer, Geo. F. Porter ; Master of Transportation, C. O. Baker, Jr.

Executive Committee, Charles R. Huntley, Buffalo,

Brophy, Chairman.

Afternoon Session, 2 o'clock.

Report—Committee on Finance, J. A. Seely, Chairman.

Paper—J. B. Cahoon, Elmira, N. Y., "Standardizing Prices for Incandescent Light and Power."

Topic—"Theft of Current and How To Deal With It."

Paper—W. Worth Bean, St. Joseph, Mich., "Municipal Lighting."

Questions and Answers ? ? ? What Is It You Wish To Know ?

Executive Session.

Wednesday, June 9th, 1897.

Morning Session, 10 o'clock.

Paper—C. L. Edgar, Boston, Mass., "Correct Method of Charging for Product."

Paper—J. G. White, New York, N. Y., "The Niagara Power Transmission Line."

Paper—Arthur Wright, Brighton, England, "Profitable Extensions of Electricity Supply Stations."

Topic—"Commercial Results with Inclosed Arcs."

Afternoon Session, 2.30 o'clock.

Paper—Professor Chas. A. Carus-Wilson, McGill Univerity, Montreal, Can., "The Induction Factor, a New Basis of Dynamo Calculation and Classification."

Paper—Professor Elihu Thomson, Lynn, Mass., "Recent Pr gress in Arc Lighting." Paper—T. C. Martin, New York, N. Y., "The Daylight Work of Central Stations."

Questions and Answers ? ? ? What Is It You Wish To Know ?

Executive Session—Evening Session, 8 o'clock, Lyceum Theatre.

Paper—L. B. Stillwell, Niagara Falls, N. Y., "Niagara Power." (Illustrated with Stereopticon.)

Thursday, June 10th, 1897.

Morning Session, 10 o'clock.

Paper—B. F. Lamme, Pittsburg, Pa., "Polyphase Motors."

Topic—"Best Efficiency for Incandescent Lamps."

Paper—Lieut. F. Jarvis Patten, New York, N. Y., "Frequency Transformation."

Topic—"Are the Large Arc Lighters Commercially Desirable ?"

Afternoon Session, 2.30 o'clock.

Topic—"Lamp Carriers Other Than Ordinary Posts."

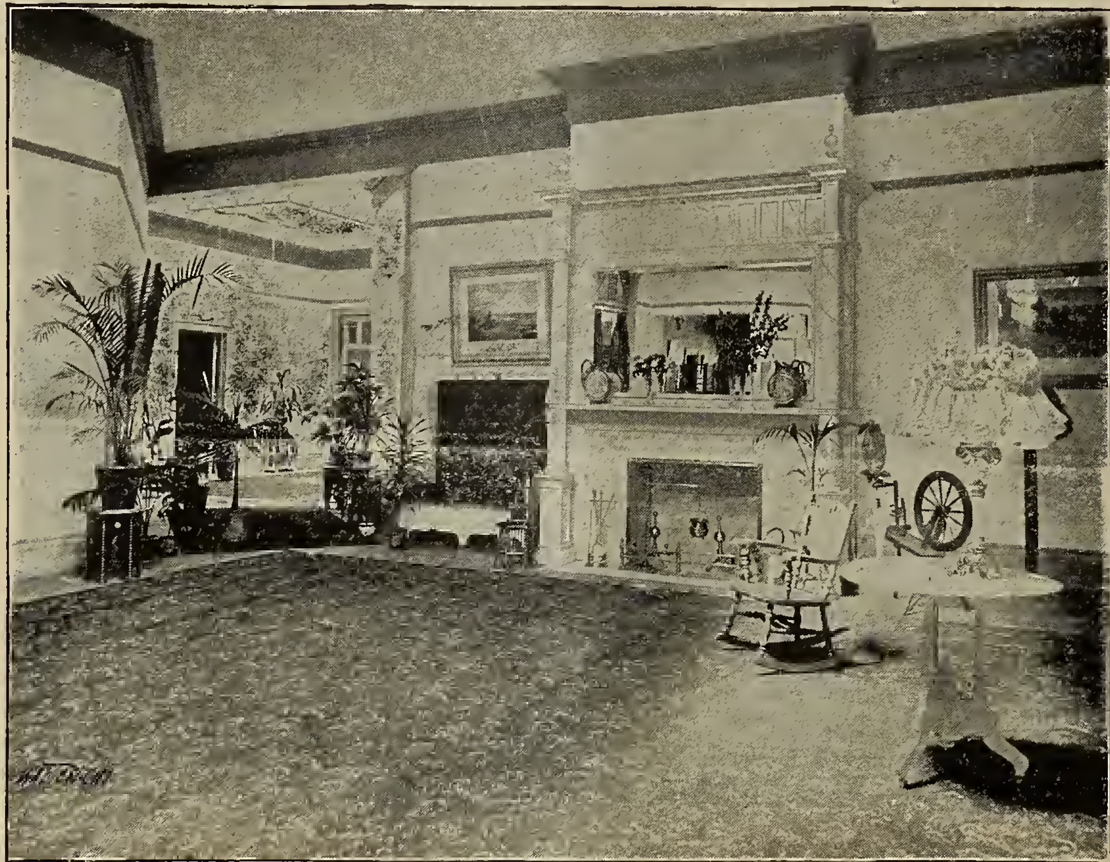
Paper—C. F. Scott, Pittsburg, Pa., Rotaries for Transforming Alternating into Direct Current."

Executive Session.

Reports—Secretary and Treasurer. Executive Committee. Election of Officers.

Insignia.

Officers.—Red Bow.
Executive Committee.—Blue Bow.
Active Members.—Red Ribbon.
Associate Members.—Blue Ribbon.
Guests.—Olive Ribbon.
Honorary Members.—White Ribbon.



Main Reception Room.

Programme of Entertainment.

The President and Executive Committee take pleasure in announcing that invitations have been received for members and their friends to visit the following points of interest : The Niagara Falls Power Company, The Niagara Falls Hydraulic Power and Manufacturing Company, The Buffalo & Niagara Falls Electric Light and Power Company, The Carborundum Company.

Arrangements have been completed for the following excursions for delegates and guests, at very much below the usual fare. Coupon books can be had at the Secretary's office. Price, $1.00.

Niagara Falls and Lewiston R. R. The Great Gorge Route. Starting from the famous Steel Observation Tower at the entrance to Prospect Park (American side) and passing all the principal hotels, the New York Central and Erie depots, thence down a gradual grade, and traversing the whole length of the wonderful Gorge within a few feet of the water's edge.

Observation Tower, located at the entrance of Prospect Park. The Tower is 300 feet high, and from its top may be seen at a glance almost every point of interest at and surrounding the Falls.

Places of Interest.

Some of the most interesting places and points of interest to visitors are : American Falls (front view), Horseshoe Falls (front and side views), the Rapids above the Falls, the Queen Victoria Niagara Falls Park, Cedar Island, the Dufferin Islands, the Town and Battlefield of Chippewa, the Suspension and Cantilever Bridges, the

Whirlpool Rapids, the Whirlpool, the Rapids below the Whirlpool, the Gorge, the View, from the top of Queenston Heights, of the River from Queenston to Lake Ontario, Brock's Monument, the Battlefield of Queenston Heights, the stone erected by the Prince of Wales, marking the spot where General Brock fell, Prospect Park, Goat Island, The Cave of the Winds, the Terrapin Rocks, the Three Sister Islands, the Trip on the "Maid of the Mist," the Excursion to Lewiston.

Points of Interest where a small charge is made:

Brock's Monument to ascend stairs,	\$0.25
Whirlpool Rapids Inclined Railway,	0.25
Railway Suspension Bridge, return fare,	0.10
Clifton Inclined Railway, return fare,	0.10
Table Rock House, Rubber Suit to go under the Falls,	0.40
Old Burning Spring,	0.25

These notes regarding points of interest are for the purpose of preventing excessive charges from being made. There is every indication that the Association will meet with unqualified success, as the surroundings, list of papers and hotel accommodation leave nothing to be desired.

A SUCCESSFUL THIRD-RAIL SYSTEM.*

The running of a car filled with 75 people over the main line of a steam railroad for a distance of 13 miles, the propelling power being electricity generated at the starting-point, is the greatest advance yet made in the field of electric traction. It is the first time in history that a road of that length hitherto operated exclusively by the steam locomotive has carried an electrically driven car, and the experiment is full of portent and hope for improved methods in passenger and freight transportation the world over.

The road that has had the courage to go to the enormous expense which the carrying out of the experiments of electric traction on its system entailed is the New York, New Haven and Hartford Railroad. The attention of President Clark had been early called to the possible advantages of electrical traction, but the fact that electricity as a tractive force had been employed but for a comparatively short time naturally deterred him from launching forth in a new direction which might necessitate a very large expense and eventually have to be thrown out as useless.

At that time no really serious work in the direction of the application of electricity to the steam road had been made beyond the equipment of the city and South London line, a short road running underneath the Thames River in London, England. This was not considered sufficient proof of the feasibility of electricity as a reliable motive power for a system with so many branches that could be advantageously operated by electricity as the New York, New Haven and Hartford system. The President, therefore, turned a deaf ear to the assurances of electricians and preferred to wait two or three years until electrical apparatus had been brought to a higher pitch of perfection and could be relied upon to do the work which he had in mind.

One of the Motor Cars.

Meanwhile, an overhead railway, six miles long, had been completed at Liverpool, England, upon which trains of two cars were operated under a two-minute headway, taking the current from a third rail set between the two running rails upon insulators of white porcelain. Two months afterwards, the well-known Intramural Railway at the Chicago Exposition was opened. On this, four car trains consisting of one motor car and three trailer cars were operated by electricity exclusively taking the current from a third rail set outside the wooden guard rail and mounted upon insulators; the contact shoe or sliding trolley being hung from the side of the cars. The success

* A more detailed account of the system described in issue of May 22, 1897.

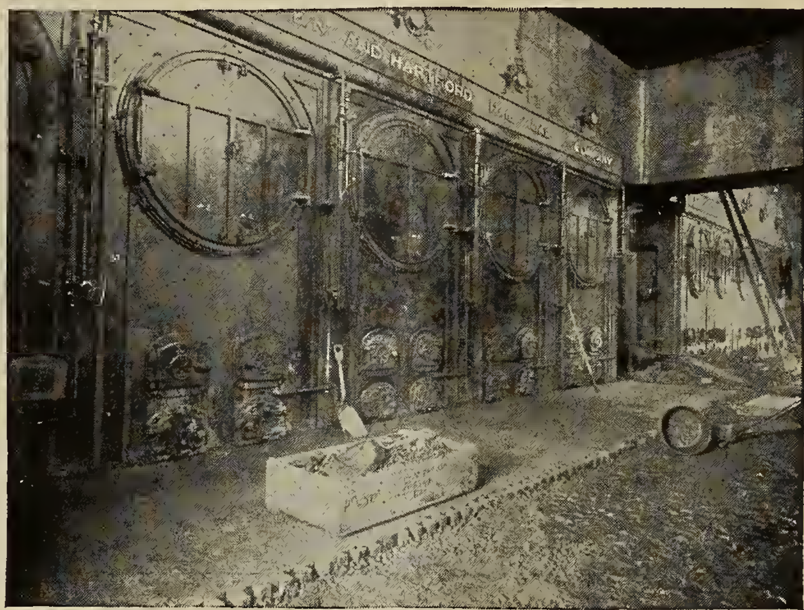
of this road was undoubted, both from the point of view of perfection of travel and economy in operation. It was a pleasure to ride in the cars through the magnificent buildings of the World's Fair, and the receipts fully realized the predictions of the Edison and Thomson-Houston electricians who had ventured on this important experiment.

This was in 1893. In the summer of 1894 a new elevated railroad in Chicago—The Metropolitan West Side—built to be operated like the Manhattan Elevated Railroad with small steam locomotives approached completion. The directors had been impressed with the success which had attended the experiment on the Intramural Railway and entered into negotiations with the same company that had installed and operated it. It was proved to their satisfaction that electricity could as well be used on a permanent elevated railway as on a temporary experimental track, which in addition to very heavy traffic conditions was complicated by an excessive curvature in the line, and the order was given to equip the Metropolitan Elevated road with electricity.

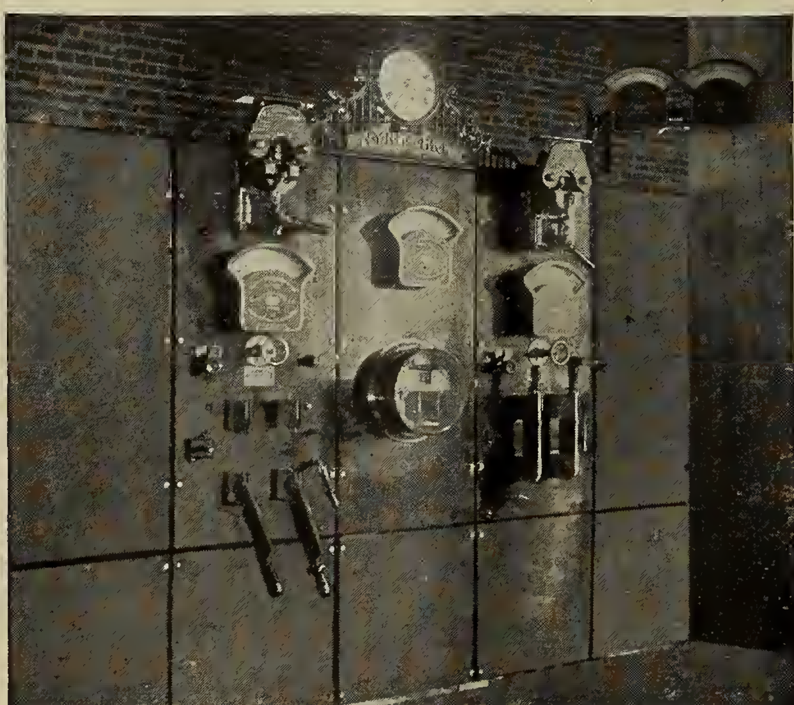
This road was opened early in the summer of 1895. The trains are made up of one motor car and three trailers, and the road has been run since that date without hitch of any kind so far as the electrical portion is concerned.

During the latter months of 1894 President Clark, who had been closely following these experiments, and who had been made aware of the intention of the Baltimore and Ohio Railway to operate the Belt Line Tunnel running under the city of Baltimore by means of electric locomotives capable of handling the heaviest freight trains, again took up the question of giving electricity a trial on some part of his road. The New York, New Haven and Hartford Railroad was beginning to feel the competition of the trolley roads in Connecticut which were paralleling its line at various points and eating into the receipts for local traffic. The advantages likely to be derived from the electric operation of some branch of the road were carefully canvassed with the most expert electricians which the Edison and Thomson-Houston Companies, which had been merged into the General Electric Co., could command, and in March, 1895, it was determined to begin the important experiment.

The man necessary to carry out the work, according to President Clark's idea, was a hard-headed, practical, mechanical engineer, of executive ability, not confused by the perplexing theories of the electrical engineers proper—one whose training had been in the school of hard practical work. He selected for this purpose Col. N. H. Heft, of Bridgeport, Conn., who had organized the Bridgeport Traction Co. and other trolley companies, and was versed in the practical side of the electric traction industry. Col. Heft was made chief of the electrical department of the New York, New Haven and Hartford Railway and it is under his supervision that the experiments on that road have been made.



Battery of Boilers.



Switchboard.

The Electrical Age.

Established 1883.

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CONTENTS.

THE DIRECT CONVERSION OF HEAT INTO ELECTRICITY.

A lecture was delivered before the New York Electrical Society, Thursday, May 20th, 1897, on The Direct Conversion of Heat into Electricity, by H. Barringer Cox. From beginning to end the lecture was closely followed by an interested and appreciative audience. It can be understood that Mr. Cox's experience with the thermo-electric generators have been varied and his conclusions, as deduced from a series of practical efforts at least, unique. The difficulties that beset his path he attacked separately, after having classified them under three headings. *First:* The oxidation of the joint between the thermo couples. *Second:* The disintegration of the element, and *Third:* The fragile nature of the element. This evidence of system is highly commendable on the part of Mr. Cox, as it frequently happens that the evolution of a device is retarded for years by the irregular developments of its parts.

The exclusion, therefore, of one *class* of troubles after another is the superior method of procedure. A curious statement by Mr. Cox, to the effect that a greater cold in the outer class of joints or a greater heat inside did not increase the E. M. F. of the couples, was explained by Prof. Crocker. He claimed that only a certain difference of temperature can be maintained between the ends of an element on account of the limited heating surface. Therefore increased heat at one end or greater cold only preserves this difference as before.

The remarks of Mr. Cox were of a very practical nature, as they referred to the subject only on the basis of his own experience and from no scientific standpoint whatever.

A great deal of discussion arose regarding the output of the thermopile. The test advocated for the purpose of determining this voltage by Mr. Dunn was to short-circuit the machine through the ammater. Then we know when it is giving half the number of amperes it is giving the maximum number of volts at half the voltage on the open circuit.

The thermopile has in the past possessed defects which were called inherent because they were supposedly ineradicable; but in the light of Mr. Cox's results there is every possibility of its being used for a variety of purposes with the same sense of reliability and appreciation of its purpose as that associated with the incandescent lamp or electric motor.

Mr. Cox's lecture has illustrated an almost axiomatic principle that relates not alone to the thermopiles but to every class of useful apparatus. It is this: That unless a given construction is hampered by a series of insurmountable objections it is worth while laboring patiently and persistently for the purpose of overcoming them, as their very existence is proof of a lack of application on the part of those whose unsuccessful attempts are thus recorded. Mr. Cox has the satisfaction, which scientific honors do not always bring, of having achieved something that the greater masses can understand—of having completed something whose immediate use and direct application will appeal to them more strongly than a discovery whose mysteries are utterly beyond their sense of real appreciation.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

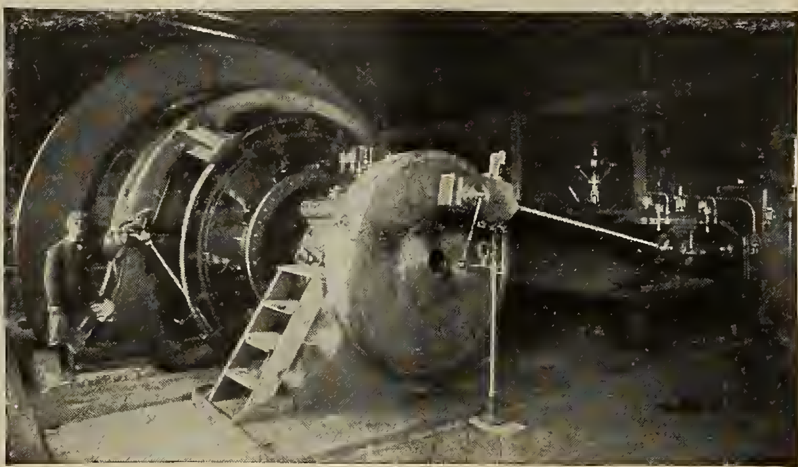
The National Electric Light Association have become an organization of considerable influence and power. Their annual conventions held at various points of interest are much more than pleasure excursions, as proven by the collection of excellent papers read and discussed on such occasions. The list of subjects covered is somewhat extensive, though as a general rule they are in touch with some branch of electric lighting or power transmission. One topic the discussion of which is being waited for with ome curiosity deals with "Commercial Results and Inclosed Arcs." The approaching convention at Niagara Falls promises to be an unqualified success, there being a very well chosen list of subjects and the pleasantest of surroundings. The International Hotel will be the scene of much serious work as well as social communion, being the regular N. E. L. A. headquarters.

There are so many points of interest to visit at Niagara of a scenic nature, and so many electrical industries in full operation, that visitors will be kept busy taking them all in in the limited time at their disposal. For the benefit of such of our readers as will attend the convention the order of proceedings and principal points of interest have been incorporated in an article for reference when required.

There is one cliff at Niagara from which issues many streams of water. Each represents the power supply of a different corporation—an aluminum works, lighting station or power station, etc. The immense possibilities in store for Niagara cannot fail to impress the visitor. It is the great power centre of the future, and the N. E. L. A. have done well in their choice.

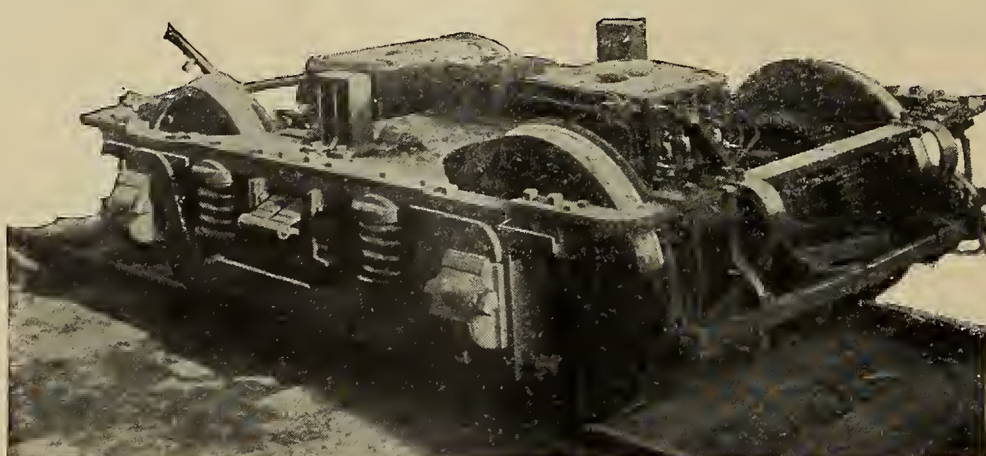
The following named out-of-town visitors are registered at the office of the National Electric Light Association, 136 Liberty street, New York, for the week ending May 21: Louis C. F. Schaffer, Antwerp, Belgium; E. G. Bernard, Troy, N. Y.; Geo. A. Redman, Rochester, N. Y.; H. B. Cutter, Philadelphia, Pa.; H. P. Jagoe, Tappan, N. Y.; R. T. McDonald, Fort Wayne, Ind.; Ernesto F. De Castro, Nassau, N. P.; R. Xiques, Havana, Cuba.

The first stretch of road selected was that which runs along Nantasket Beach. This was a singularly difficult part of the system six miles long with five miles in curves. A large power house was laid down a few hundred yards from the point where this branch line joins the main line of the South Shore Branch of the Plymouth division. It was not felt at that time that sufficient experience had been had with the third-rail system to allow of its being laid down on this experimental line, and a trolley system was therefore adopted. The trolley wire was suspended from brackets fastened to large, heavy poles set between the tracks. At stations and at the junction the trolley line was suspended from light steel arches thrown across the track. The first cars used were baggage cars having two 125-h. p. motors suspended to each truck and two trolleys. The operation of this experimental road was more than gratifying, and fully realized the expectations of President Clark, Col. Heft and the electrical company which supplied the apparatus.



One of the 1200 H.-P. Generating Units.

Nantasket Beach is the Coney Island of Boston, and on Sundays immense crowds of people flock there for the day's outing. The traffic is so dense that the steam road which had run there previously could never cope with it. With electrical trains made up of a baggage motor car and open trailer cars with a seating capacity of nearly one hundred people each, the business was for the first time successfully carried on, and the electrical installation became the Mecca of every visiting railroad engineer from all parts of the world.



A 125 H.-P. Motor Truck.

In 1896 President Clark took up the question of the third rail and determined to lay it down for a short distance on the main line itself running from Nantasket Junction to East Weymouth on one track and back on the other. The two feeders were run from the power house and joined to the rail at the junction, and the cars which ran along the Nantasket Beach section continued their journey on to East Weymouth, passing from the trolley line to the third rail without any difficulty. The boldness of this experiment received its due reward. The third rail operated with absolute suecess, and the word was given to equip a new stretch of track running from Berlin, Conn., to New Britain, on the New York and New Haven Railway, Hartford division, and from New Britain to Hartford on the New England Railroad, Springfield division.

This is the line that was opened on Monday last by President Clark, all the important officials of the New Haven and New England systems, and the engineers of the General Electric Company, which had furnished the generating and motor apparatus. The importance of this event can hardly be conceived. If this long stretch of track, nearly thirteen miles long, can be operated with success from the standpoint of the steam railroad engineer, its influence upon every other railroad can very readily be prognosticated. It will prove that electricity, as a motive power for railroads hitherto operated by steam, is practically the only power which can advantageously be used upon the branch lines of this country which operate as feeders to trunk lines, and that it will be the only system tolerated for suburban passenger traffic. There is still the question of expenditure and countervailing receipts, and the development of a system which will convey electricity over long distances economically to be sifted and settled, before electricity can be applied to the trunk lines; but who can doubt that this will eventually come, when it is remembered that it is not ten years since it was first proved that the trolley car could supersede the horse car and earn dividends for roads that had been losing money so long as they were operated by horse traction.

It should be borne in mind that apart from all considerations of comfort and speed, electricity has this advantage over the steam locomotive : For every horse-power exerted during one hour are required in an ordinary steam locomotive from seven to nine pounds of coal, and this in the best engines and with the most economical firing. In a central power house the same amount of power in a stationary engine can be generated in the perfected engines of today for about two pounds of coal, and this can be transmitted with very little loss considerable distances, according to the system of electrical transmission employed. Manifestly, therefore, if the motive and the transmission apparatus can be depended upon, the economy in the coal alone is more than attractive to the pres-

idents of railroads operating long lines and many trains.

In equipping the new branch of this road, President Clark was determined that the very best obtainable machinery should be employed. This machinery is contained in a spacious power house, which has been erected at Berlin a few yards from the main line running from New Haven to Hartford. It is of two stories and is divided in the middle by a brick wall. One side contains the boiler equipment, which consists of ten 300 horse-power boilers in two batteries. The second story of the next room is the engine and dynamo room. The engines are of the most economical type built ; they are known as Greene-Corliss compound condensing engines, each capable of furnishing 2,000 available horse-power. The shaft of the engine carries a massive fly-wheel weighing about fifty-two tons, and armature weighing about fifty, making a total moving weight of over one hundred and ten tons.

Around the armature and resting upon its own foundation is what is known as the field of the generator, a great circle of iron carrying ten electromagnets projecting inward. It is the rotation of the armature within these that produces the electrical current. The armature turns at a speed of one hundred revolutions a minute, and the power of the dynamo is 850 kilowatts, which is, mechanically speaking, about 1,200 horse-power. This is its ordinary work; under emergencies it can furnish about 2,000 horse-power for a short time.

When the current is generated it goes underneath the floor over cables of solid copper well insulated to the switchboard. This carries the instruments, which allow the electrician to connect or disconnect the current from the third rail; the meters, which tell him how much electricity is being consumed in driving the cars, and other instruments which protect the dynamos from any accident or short circuit on the line. A short circuit produces a sudden rush of current, and if this sudden rush had to pass through the dynamo the electricity would probably greatly damage it; so that, when a short circuit occurs on the line, the rush of current trips a little latch, a switch is opened by a spring and the circuit is broken.

From behind the switchboard four copper cables, each ab ut one inch in diameter, run underground and are connected to the third rail in front of the power house. This is the only connection between the third rail and the dynamo. There are no feeders. This third rail is shaped like a capital A flattened at the top. It is rolled in the same length as the ordinary rail and weighs ninety-three pounds to the yard. It naturally has to be insulated from the ground and raised so high above it that the water shall fall off it and not allow the electricity to escape. Creosoted wood is a good insulator and is moreover very cheap. The third rail rests, therefore, upon conical blocks of creosoted wood set on wooden pins let into the ties. The rail is simply lain on these blocks and is held there by its own weight.

The third rail has to be continuous, in order that the electricity shall have a continuous passage ; if it had not there would be no circuit, and if there is no circuit there is no electricity. Every length of rail must, therefore, be joined to every other. This is done by putting two copper plates under the eave of the rail at each joint and bolting them there. This gives a perfectly unbroken path for the current. The electricity must also get back to the dynamo, and it is the aim of every electrical engineer who lays down an electrical railroad to get as much of the current back as possible. The path for this return circuit, as it is known, are the rails upon which the cars run. It is necessary, therefore, to bond these also, and this is done by putting a heavy strip of copper beneath the foot of the track rails at each joint. Col. Heft has paid especial attention to this question of return, well knowing that any electricity which does not get back to the dynamo will have to come back by the ground, and when electricity comes back by the ground it comes along over water and gas pipes. When electricity returns by way of the pipes, the natural result is the damage suit for electrolysis. On this point most of the trolley roads in this country have had considerable experience.

Following the path of the current, the electricity goes from the third rail into the motor, and from the motor back to the track rails and thence home to the dynamo.

The motor cars which will be used on this line are open cars fifty feet long, each equipped with two motors hung on one side of the trucks. Each motor is of 125 horse-power. Each car has a seating capacity of about one hundred people, and is practically the same as those used at Nantasket.

The current is taken from the third rail by a flat piece of cast iron known as the "shoe," hung by two links immediately beneath the king pin of each truck ; it weighs about twenty pounds and is twelve inches long and four inches wide.

From the shoe the current goes to a controller, in appearance similar to those used on trolley cars, only very much larger. There is one on each platform. A very pretty principle of electricity is applied in these controllers in a device invented by Prof. Elihu Thompson. When an electric current is broken there is always an arc. If the arc were allowed to continue it would quickly burn off the metal contacts. It must therefore be extinguished. This is done by means of an electromagnet. At the same moment at which the arc is formed the current passes around a horseshoe-shaped piece of cast iron, making a powerful magnet, and the magnetic rays issuing from the poles of this magnet have the effect of immediately blowing out the arc. From the controllers the current goes to the motors, where it does its work.

The motors have also to be protected from sudden rushes of current, and protective devices are placed under the hoods of the car. These devices or circuit breakers are similar to those on the sw.tchboard, but are of course smaller. The remainder of the equipment of the car consists of two big gongs, a whistle and the necessary air-brakes. The air for the brakes and the whistle is supplied from an air-pump placed on one of the platforms. The operation of this air-pump is automatic and very ingenious. It is driven by a motor which is connected to and disconnected from the circuit by a little switch. When the pressure in the tank has reached about ninety pounds, the switch is opened and the motor stops working ; when the pressure falls after the brakes have been applied or the whistle blown, the switch is closed and the motor starts. The motorman has nothing to do with this; it works itself.

The safety of the public is not the smallest consideration which perplexed the engineers of the New Haven Railway. On their own right of way the public would trespass at its own risk, but at the stations and crossings safeguards must be provided. At Berlin and at Hartford stations the third rail and track are fenced in, and no one can reach the electric rail unless he either climbs the fence or crawls under the car from the other side. At New Britain, where the tracks of the New York, New Haven and Hartford road and the New England road converge, mere fencing is not sufficient. Here the tracks make a "Y" and the movement of the track switches is controlled from a switchman's box in the "Y." From each section of this rail, which of course is here very much broken, a copper cable runs to the switch tower. When the switchman is notified of the approach of a train he closes an electrical switch and makes the third rail "alive." When it is in the station he cuts the third rail out and makes it "dead." When it is ready to start again he closes the switch and does not open it until the car is out of the station and the third rail becomes "dead" again.

At all crossings the third rail is omitted ; the circuit is continued from the end of one stretch to the beginning of the other over a copper cable about an inch in diameter. These cables are laid in a wooden tube, and the

tubes are filled with insulating material. They are then laid in a wooden box filled with insulating material, and buried about a foot beneath the soil. In order that the shoe should strike the third rail without jar a block of wood forming an inclined plane is placed in front of each section; the shoe runs up this until it reaches the third rail.

There is a distance of thirty-three feet between each shoe on the car. At crossings less wide than this there is always one shoe in contact, but at crossings wider than this the car would have to pass over by its own momentum if the shoe were out of contact. Another shoe is therefore placed on the trailer car and this shoe furnishes the electricity until the first shoe on the motor car can reach the third rail again.

The first car that was run over this line was run early on Monday morning. It was a very undress rehearsal. Col. Heft is a bold man and drove the car at a speed which was nearer one hundred miles an hour than seventy-five. At the dress rehearsal with the president and officials aboard the speed was about fifty miles an hour. The road will go into regular service probably tomorrow.

THE MOTOR.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

A motor to satisfy the demands of modern design must fulfil certain functions. In earlier days Page made a motor which depended upon the suction or attraction of a helix for a soft iron core. The entire mechanism otherwise represented the details of a steam-engine. The slide-valve was duplicated by means of a contact-piece. Although the apparatus rotated, producing power and motion, it was not efficient, or at present more than historically interesting. From the first experiment of Œrsted sprang a host of inventions. Jacobi, working under the patronage of the Czar of Russia, built a small boat run by a motor which was used on the river Neva. In Germany many machines were produced that clearly showed the easy transformation of electric into mechanical energy. In America, Froment and others set to work constructing small motors for practical purposes. A motor is today the most efficient machine in existence. Its principle of action is not less interesting than singular. In one respect it departs from the regular beaten path in utilizing power in a unique manner. Stripping the machine of all elaborations, it is to be seen that the attraction and repulsion of magnetic poles causes the rotation. It is necessary to have in every motor a source of magnetic power. No matter how rude the construction, this is an essential part of the device.

A bar of iron may be rotated in front of this magnet, attracted to a certain point, and then by means of its own momentum allowed to swing around and present its other end for attraction. In so simple a contrivance we have the elements of a modern motor. To enable the current to act in order that the magnetizing effect is automatically supplied when needed, a commutator is used. A switch which controls the current, acting by means of rotation, is the addition required. In large motors the field is kept constant. When a motor is started the field is the first part energized. The necessity for this will be explained later on. When the field is ready, rotation of the armature ensues as soon as current is let into it. The armature consists of a cylindrical body of iron upon which is wound coils of wire. These coils are connected to a commutator so that they are each individually attracted in rotating through the field. The armature is nothing more nor less than a compact form of magnet with innumerable poles.

If the armature rotates in a magnetic field, it does so because each of these coils individually are attracted by the current; this is effected by having a series of metallic strips composing the commutator connected to the ends of each coil. When these coils are made magnetic they move towards the nearest oppositely magnetized pole piece and rotation at once ensues.

This process is regularly occurring with every coil,

Motor Carriage Equipped with Lundell Motor.

and results in a rapid and even spinning of the armature.

In considering the dynamo it was observed that the conductors cutting lines of force generated an electromotive force. In a motor we also have conductors cutting lines of force; therefore an electromotive force is likewise produced.

Crocker-Wheeler Electric Company. Gives 2 H. P. and 100 R. P. M. Proportionate Powers at other Speeds.

It is necessary to appreciate this fact in order to understand the scientific meaning and bearing of the term efficiency. If the electromotive force generated in a motor while rotating were by any possibility equal to that sup-

Motor Carriage Equipped with Lundell Motor.

plied the motor would stop. There is always a difference between them, however, which depends upon the load of the motor.

If 100 volts were applied to the motor it might generate within its *armature* 90 volts; therefore only 10 volts can be effective in forcing current through it. The resistance of the armature must be low enough to allow sufficient current to pass at 10 volts pressure to do the work required. This adjustment is continually occurring between the load on the motor and the pressure generated within it. In this respect a motor is perfectly automatic and requires but little outside aid in certain types to overcome many difficulties hampering the speed.

The pressure created in the motor by its armature rotation is called *counter or back E. M. F.* The ratio existing between the counter and applied E.M.F. is a measure of the *electrical efficiency* of the motor.

$$\frac{\text{Back E. M. F.}}{\text{Applied E.M.F.}} = \text{Electrical Efficiency.}$$

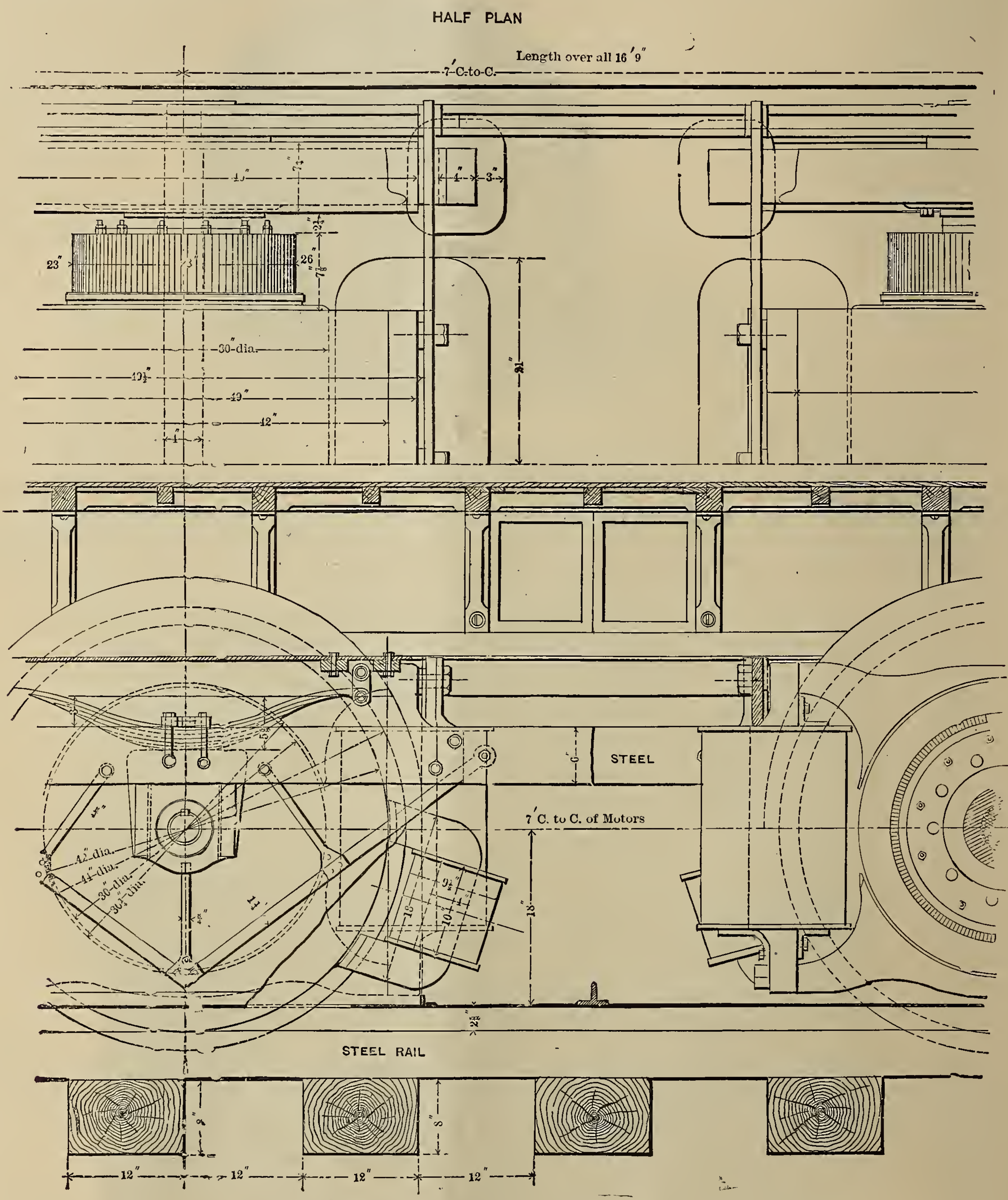
The more rapidly a motor speeds up the greater becomes the counter E. M. F. with a constant field. The back E. M. F. becomes more and more identified with the applied E. M. F.

The armature takes less and less current, and in electrical efficiency the motor approaches its ideal value.

The *commercial efficiency* is the ratio existing between the power obtained from the motor and the power applied.

the volts and amperes it consumes measured. The speed of the motor is taken and the pull in pounds measured on the periphery of the pulley. If the following data be considered the process will not be confusing.

Test of a motor. volts, 100
amperes, 10
speed, 2,000
pull, 5 lbs.



Motor Used for Traction. (150 Miles an Hour.)

A motor cannot have a high commercial efficiency with a low electrical efficiency.

$$\text{Commercial efficiency} = \frac{\text{Power received}}{\text{Power applied.}}$$

Each watt entering the motor equals 44.2 ft. lbs. The power applied can therefore be calculated. The power received from the pulley of the motor is obtained by means of a brake. It also represents foot pounds. In large motors this may be equal to 90 per cent.; the electrical efficiency may equal 95 per cent. in the same machine. To test a motor its load is entirely applied and

pulley = 1 ft. diam.

Power entering = $10 \times 100 = 1{,}000$ watts
$= 44{,}200.0$ ft. lbs.

$$\text{Power received} = \frac{\text{Circumference of pulley} \times \text{speed} \times \text{pul}}{33{,}000}$$

$$= \frac{3\text{ ft.} \times 2{,}000 \times 5}{33{,}000} = \frac{30{,}000}{33{,}000}$$

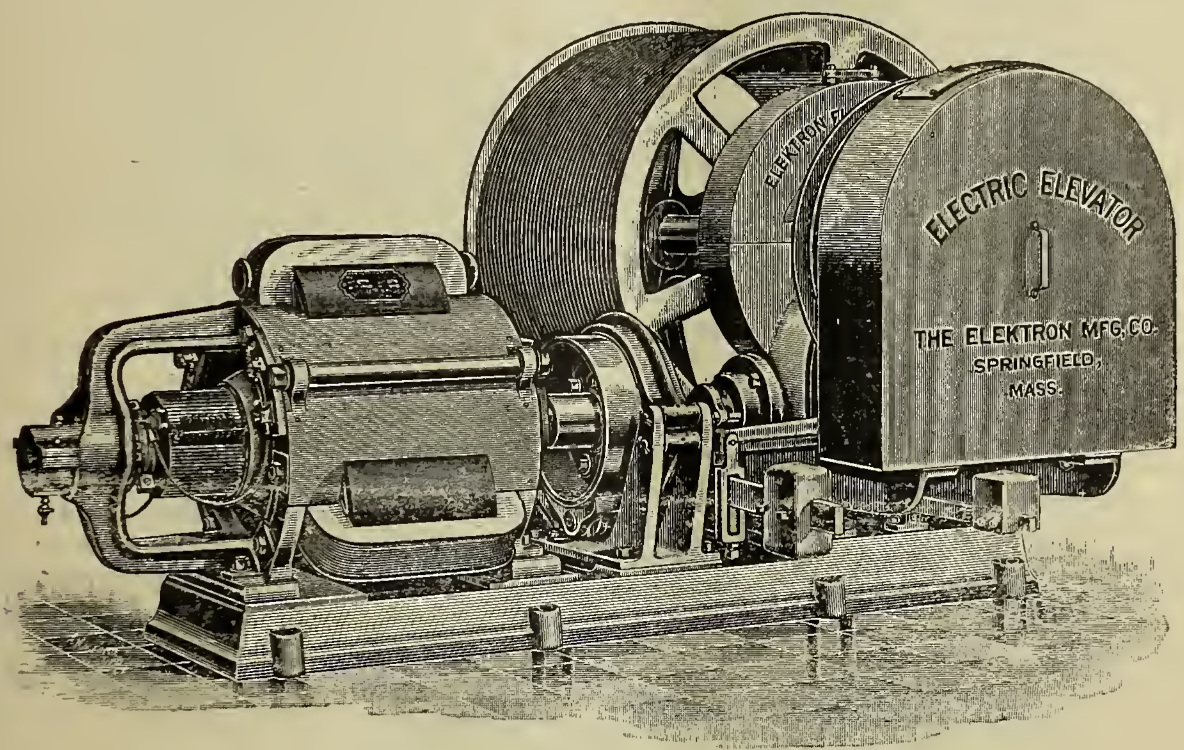
$$= \frac{9}{10}\text{ H. P.}$$

The commercial efficiency therefore is quickly found.

$$\frac{\text{Power received}}{\text{Power applied}} = \frac{9 \text{ H. P.}}{10 \text{ H. P.}} = 90 \text{ per cent.}$$

"THE GLAD HAND."

The above illustration shows a few of the many applications of the "Glad Hand" indicating globe. The Glad Hand is the invention of Mr. Davis, and is manufactured and sold by the Phœnix Glass Co., manufacturers of elec-



Electron Motor Applied to an Elevator.

tric and glass globes, shades, etc., of 413 Penn avenue, Pittsburg, Pa., and 42 Murray street, New York.

The glowing hand with prominent index finger cannot fail to save a great deal of inquiry and gray matter regarding the whereabouts of the places thus pointed out.

Savannah, Ga.—The Edison Electric Illuminating Co., George J. Baldwin, Charles A. Stone, and Edwin S.

Uses of the "Glad Hand."

Webster, have applied for incorporation; to build a plant for supplying electric light and power. Capital stock, $100,000.

THE SYNCHRONOGRAPH.*

A New Method of Rapidly Transmitting Intelligence by the Alternating Current.

BY ALBERT CUSHING CREHORE AND GEORGE OWEN SQUIER.

(Continued from page 333.)

The following example will make more evident the application of Faraday's discovery to this receiver. Admit a beam of ordinary light through a small aperture into a dark room and let it fall upon a white screen. Suppose that the aperture which admits the beam is provided with a shutter which may be opened or closed at will. We have in this simple arrangement all the essentials of a transmitter and receiver of intelligence. A person opening and closing the shutter might communicate with a second person observing the screen, which would become light and dark at intervals in accordance with a pre-arranged code. Substitute for the first person in direct control of the shutter an electromagnetic device operated from any desired distance through an electric circuit, and

the effect upon the screen is the same as before. For rapid transmission it would be necessary to substitute a mechanical transmitter which would operate faster than a person can send by hand. There would be no particular difficulty in thus moving the shutter more rapidly than any observer could read from the screen. It then becomes necessary to make a permanent record, which may be accomplished by substituting for the screen a self-recording surface having a relative motion across the beam. This is afforded by using any surface sufficiently sensitive to light, many varieties of which are available. In fact a surface is available which is so sensitive that it will record much faster than the *material shutter* can be moved back and forth so as to open and close the aperture.

The next step in increasing the speed, provided the limits of the transmitter have not already been reached, is to secure a more rapid shutter. It was with this object in view, to obtain a *massless shutter*, that Faraday's discovery is used. Instead of passing the light directly through the aperture, it is first passed through a Nicol prism in order to obtain a beam of plane polarized light, or it may be polarized in any other suitable manner. Suppose that a second Nicol prism like the first is placed in the path of the polarized beam. If the second prism known as the "analyzer" is turned so that its plane is perpendicular to that of the first prism known as the "polarizer," all the vibrations not sorted out by the polarizer will be by the analyzer. In this position when the planes are perpendicular to each other, the prisms are said to be "crossed," and an observer looking through the analyzer finds the light totally extinguished as though a shutter interrupted the beam. By turning the analyzer ever so little from the crossed position, light passes through it, and its intensity increases until the planes of the prisms are parallel, and if one of the prisms is rotated, there will be darkness twice every revolution. In order to accomplish the same end that is obtained by rotating the analyzer without actually doing so, the following plan is adopted: Between the polarizer and the analyzer is placed a transparent medium which can rotate the plane of polarization of the light, subject to the control of an electric current, without moving any material thing. The medium used in this receiver is liquid carbon bisulphide contained in a glass tube with plane glass ends. There are many other substances which will answer the purpose, some better than others. This was selected because it is very clear and colorless, and possesses the necessary rotatory property to a considerable extent. It only possesses this property, however, when situated in a magnetic field of force, and the rotatory power is proportional to the intensity of the magnetic field. To produce a magnetic field in the carbon bisulphide, a coil of wire in series with the line from the transmitter is wound around the glass tube. When the current ceases, the carbon bisulphide instantly loses its rotatory power. The operation is as follows: First the polarizer and analyzer are permanently set in the crossed position, so that no light emerges from the analyzer. A current is sent through the coil around the tube. The plane of polarization is immediately rotated. This is equivalent to rotating the polarizer through a certain angle, and hence light now emerges from the analyzer. Interrupt the current, the medium loses its rotatory power, and there is again complete darkness. The arrangement makes an effectual shutter for the beam without moving any mass of matter.

This illustrates how Faraday's discovery may be utilized to replace the electromagnetic shutter in the above example by a massless shutter, which enables the current waves sent over the line to be recorded upon the sensitive surface without moving any material thing. An advantage of this receiver is that the speed is not limited by the receiver but only by the natural properties of the line or of the transmitter. Used in connection with the transmitter already described, the real limit is found to be in the line itself.

An analysis of this receiver shows that the energy received over the line is not used directly in making the record, but the agent which makes the record is the beam of light which derives its energy from a local source. The energy received from the line merely controls this local energy, which may have considerable power behind it. This controlling phenomena is one of the few known cases where electricity acts directly upon light. The mechanism by which this action is effected is not at present known, and any experimental evidence upon it would increase our knowledge of the connection between ether and ordinary matter, as well as the constitution of matter itself. The use of this direct influence of electricity on light makes the speed of transmission through the receiver comparable with the velocities of these agents.

(To be continued.)

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of the Executive Committee of the Institute on Tuesday, May 18, the following Associate Members were elected:

William C. Banks, electrician, Gordon-Burnham Battery Co., 82 West Broadway, New York City.

Edward C. Clement, ass't examiner, electrical division, U. S. Patent Office, Washington, D. C.

A. Davidson, cable engineer and electrician, Central and South American Telegraph Co., Lima, Peru.

Constant de Redon, consulting engineer, 27 Thames street, New York City.

Sidney Hosmer, superintendent underground cable department, Boston Electric Light Co., Ames Building, Boston, Mass.

Carl Kinsley, teacher of electrical engineering, Washington University, St. Louis, Mo.

John Neilson, superintendent of interior wiring department, Larchmont Electric Co., Larchmont, N. Y.

Albert S. Richey, electrician, Citizen's Street Railway Co., 403 W. Adams street, Muncie, Ind.

The following Associate Members were transferred to Membership:

W. W. Nicholson, General Superintendent Central New York Tel. & Tel. Co., Syracuse, N. Y.

R. E. Richardson, Electrical Engineer, Chicago, Ill.

Edward B. Rosa, Prof. of Physics, Wesleyan University, Middletown, Conn.

The Annual Business Meeting of the Institute was held at 12 West 31st street, New York City, and was called to order by President Duncan at four P. M. The counting of the ballots by Mr. Hamilton and Dr. Pupin who were appointed tellers resulted in the announcement of the election of the Council ticket as follows—

For President:
Dr. Francis B. Crocker, of New York City.

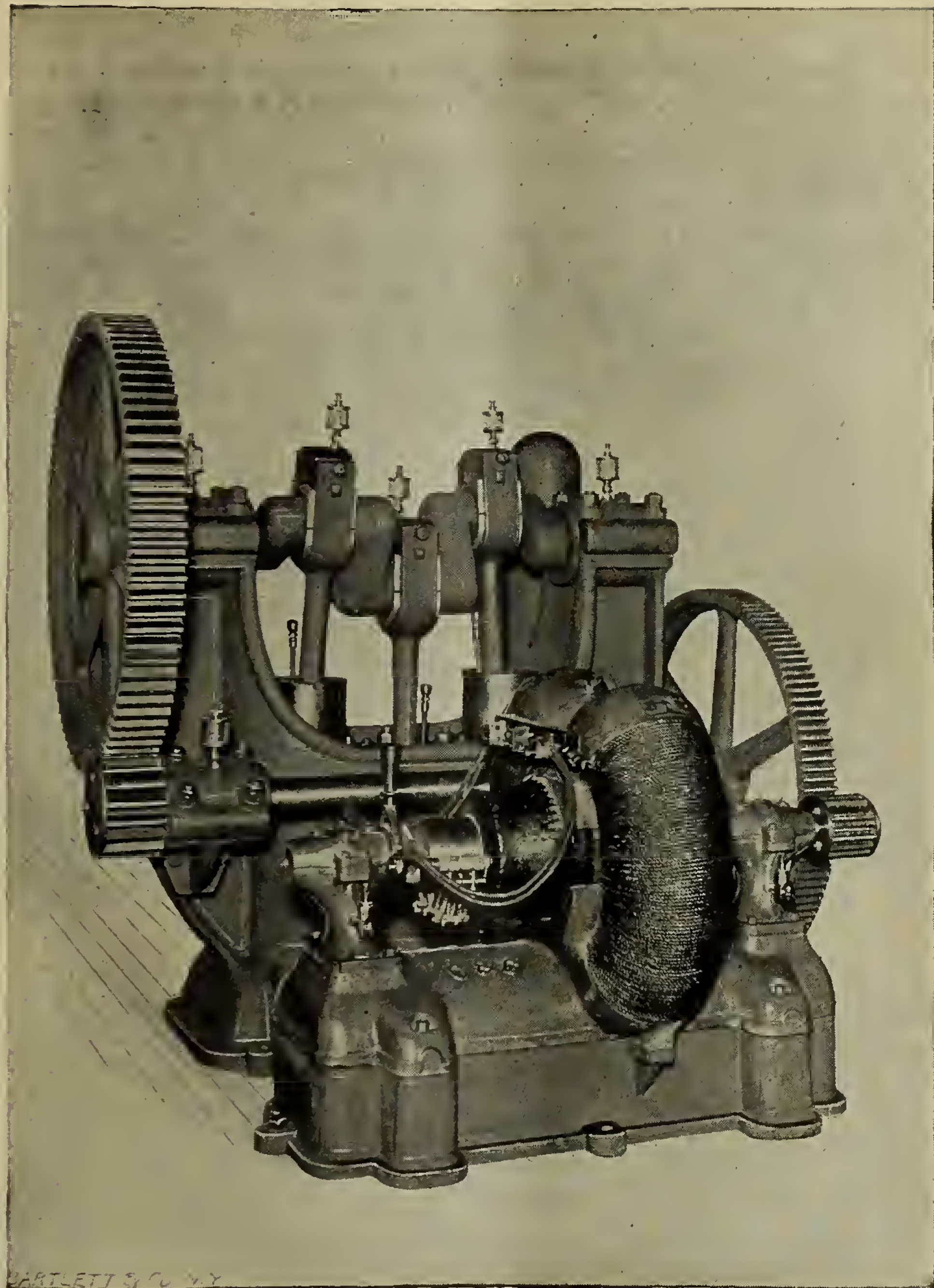
For Vice-Presidents:
Dr. A. E. Kennelly, of Philadelphia, Pa.
Mr. Chas. S. Bradley, of New York City.
Prof. Dugald C. Jackson, of Madison, Wis.

For Managers:
Dr. Alexander Macfarlane, of South Bethlehem, Pa.
Mr. Gano S. Dunn, of New York City.
Mr. W. F. C. Hasson, of San Francisco.
Mr. Herbert Laws Webb, of New York City.

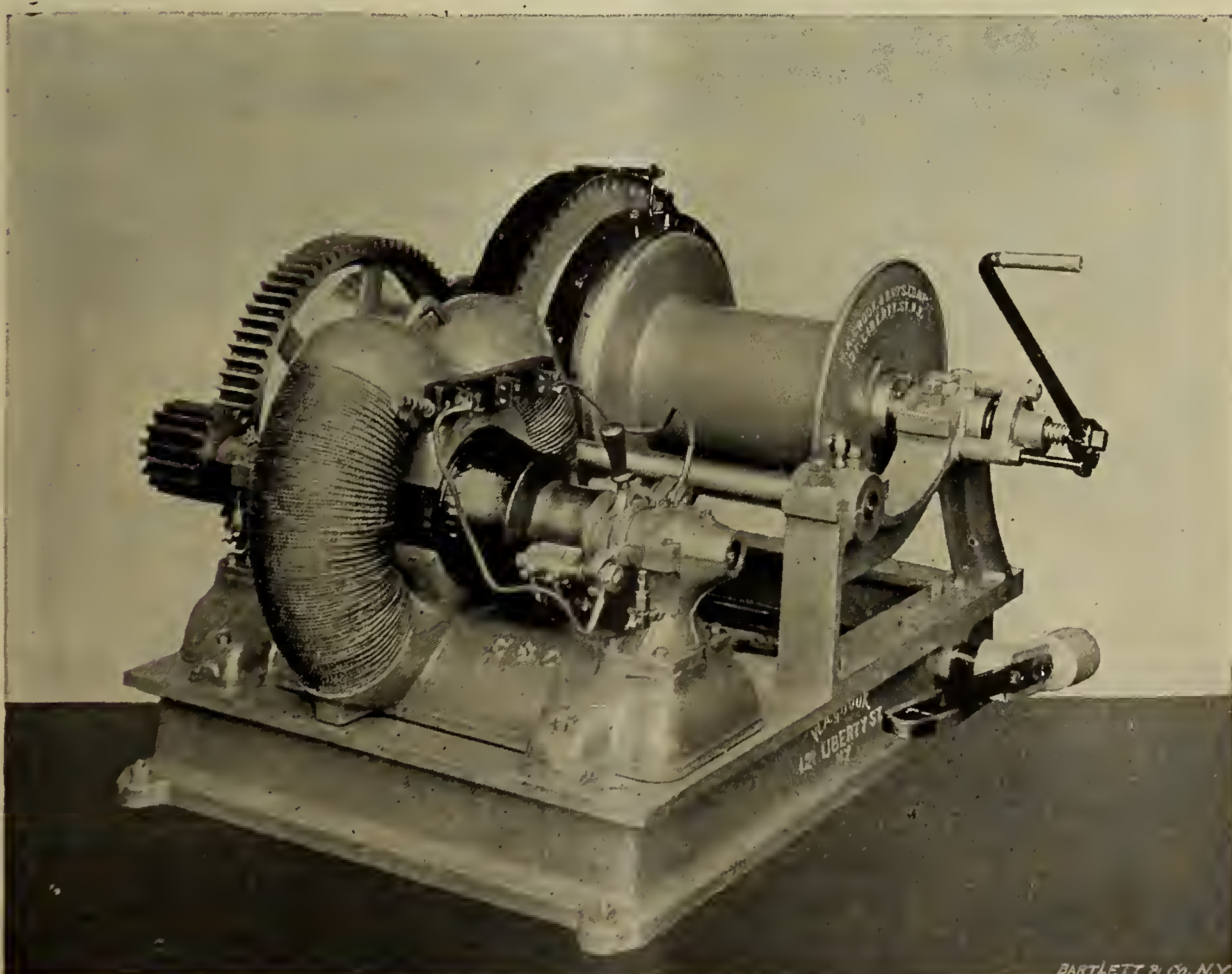
For Treasurer:
Geo. A. Hamilton, of New York City.

For Secretary:
Ralph W. Pope, of New York City.

The officers whose terms have not expired are:—Vice-presidents: Charles P. Steinmetz, of Sehenectady, N.Y.; Harris J. Ryan, of Ithaca, N.Y.; Wilbur M. Stine, of Chi-



C. & C. Electric Motor Applied to Pump.



C. & C. Electric Motor Applied to Hoist.

cago, Ill. Managers: Charles P. Scott, of Pittsburgh; Bion J. Arnold, of Chicago; Carl Hering, of Philadelphia; Cary T. Hutchinson, John W. Lieb, Jr., and F. A. Pickernell, of New York City; Wm. L. Puffer, of Boston, and L. B. Stillwell, of Niagara Falls.

The Reports of Council and the Treasurer were presented and accepted.

The report of the Committee on a new design for the Institute badge which had been referred to this meeting by the Executive Committee was taken up and thoroughly discussed, resulting finally in the adoption of the new design recommended by the Committee. Arrangements for the withdrawal of the old design and substitution of the new one will be made at an early date.

The paper on "The Synchronograph" presented April 21st by Dr. Crehore and Lieut. Squier was then taken up for discussion. Mr. F. W. Jones opened the discussion, which was participated in by Dr. Kennelly and Mr. Delany. A paper on "The Application of Hyperbolic Analysis to the Discharge of a Condenser" was presented by Dr. Macfarlane. Owing to a lack of time discussion was postponed until the General Meeting, July 26.

The announcement by the tellers of the election of Dr. Crocker was greeted with hearty applause and the President elect was escorted to the chair and briefly acknowledged his appreciation of the honor bestowed upon him.

At seven P. M. the meeting adjourned and the members immediately reassembled at the "Arena," 41 West 31st street, where arrangements had been made for the Annual dinner under the direction of Mr. Herbert Laws Webb, Chairman of the Committee on Papers and Meetings and Mr. T. C. Martin. Although a sudden increase of about fifty per cent. of the number of guests necessitated the laying of ninety-three covers, the overflow was provided for, and the event passed off pleasantly under the skilful guidance of Toastmaster Martin. Toasts were responded to by Dr. F. B. Crocker, Mr. F. W. Jones, Dr. M. I. Pupin, Dr. C. E. Emery, Dr. A. E. Kennelly, Mr. Ralph W. Pope, Mr. J. W. Lieb, Jr., Mr. Herbert Laws Webb, Mr. Nelson W. Perry and Mr. Joseph Sachs.

The exercises were interspersed with instrumental and vocal music by Mr. George Heli Guy and Mr. Charles McL. Paine. Mr. Guy played a waltz of his own composition, which he dedicated to the American Institute of Electrical Engineers.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Mr. Frank W. Hawley, chairman of the committee to receive and entertain Governor Morton at the opening of the electrical exposition last, and whose energetic efforts in connection with the gun firing and the sending of messages around the world contributed so largely to the success of the exposition, has just called at this office upon his return from a trip to Calfornia.

Mr. Hawley happened to be in San Francisco on the anniversary of the opening of the exposition, and in commemoration of the government gun firing on that occasion, which gave rise to so much agitation on the part of the city fathers of San Francisco, the military commandant at that post gave Mr. Hawley a very elaborate dinner at the Presidio, which was so timed as to be served at the exact moment at which the gun was fired just one year before.

Mr. Hawley says that San Francisco is still talking of the excitement produced on that occasion, and also says that there is a strong feeling in that city in favor of an electrical exposition there next year.

MAGNOLIA METAL COMPANY.

A letter containing the following matter has been received by us: That the firm of Sugden, Pound & Wagner of London, former selling agents of the Magnolia Co., have been dispossessed of their agency by the English courts, the London office and foreign business of the above company now being under the management of Mr. Chas. B. Miller, the president.

In addition the following firms were enjoined from making anti-friction metal: Atlas Metal Co., ltd., John Sugden, Max Wagner, Arthur George Brown, the Globe Engineering Co., ltd., and the Atlas Bronze Co.

Justice Collins gave judgment against Sugden, Wagner, Brown and the Globe Engineering Co., ltd. An appeal from the injunction before Lord Esher, of the Court of Appeals, only confirmed the decision of Justice Collins. Other piratical attempts are being made in this country, and warning is hereby given to consumers buying fraudulently stamped material.

The Riker Electric Motor Co., 45 York street, Brooklyn, manufacturers of electric carriages, have tried a number of storage batteries in the past two years, none of which being satisfactory they are now building their own cells, which gives the same output as those they have tried and weigh two-thirds less.

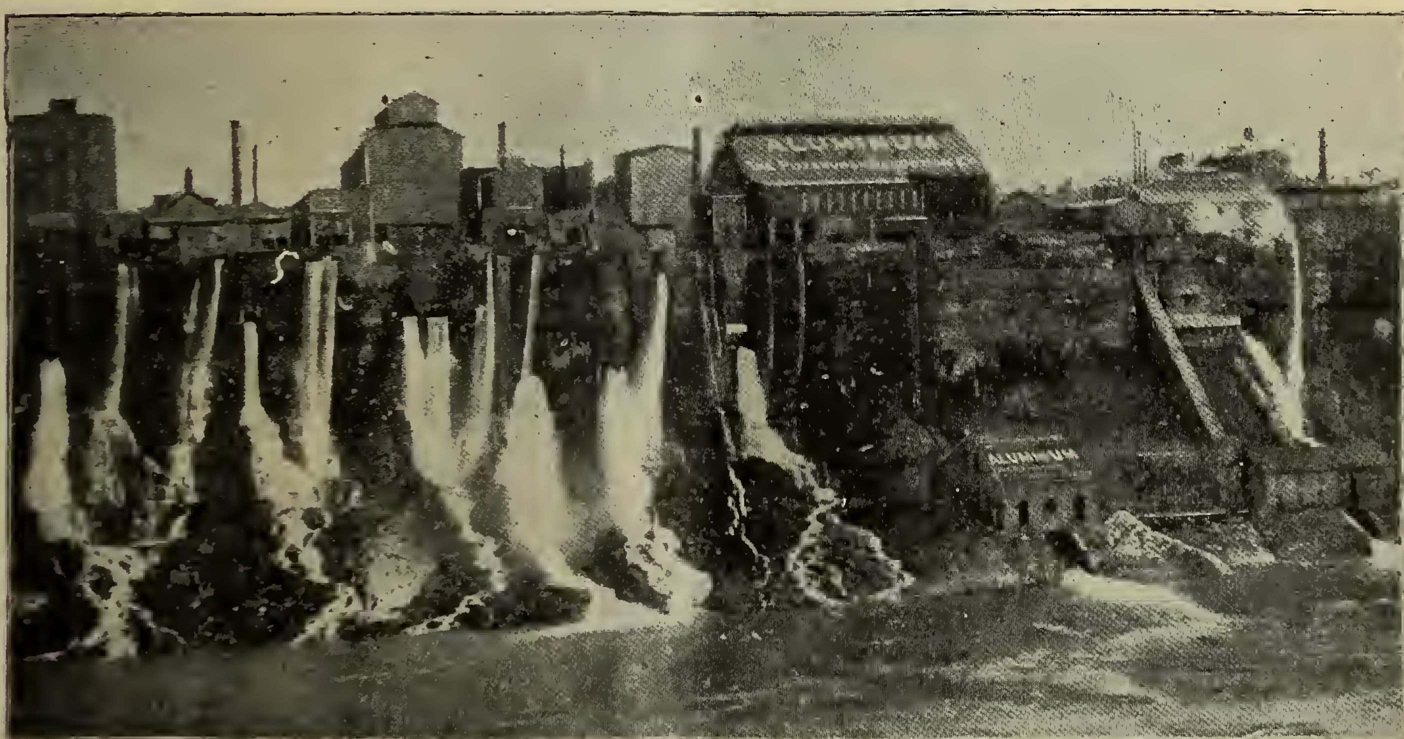
The American X-Ray Journal, a new periodical published monthly, has made its first appearance.

The application of X rays to surgery and examinations have become so important a department of a physician's vocation that this journal will find a ready sale among them. Heber Roberts, M. D., is editor. The journal states as its commendable object—Devoted to the practical application of the new science and the physical improvement of man.

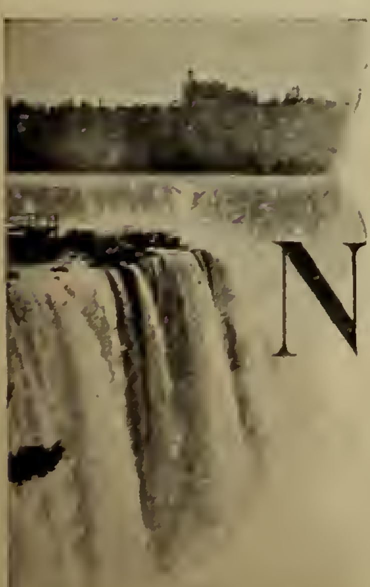
The Electrical Age.

VOL. XIX., No. 23 | NEW YORK, JUNE 5. 1897. | WHOLE No. 525

Niagara Falls.



The Money-Making Cliff.



THE CONVENTION AT NIAGARA FALLS.

NEARLY all organizations have a beginning that is more or less interesting, and the following account may prove so to some of our friends. On the 25th of February, 1885, a body of men interested in electric lighting met at the Grand Pacific Hotel in Chicago and there laid the foundation of the present National Electric Light Association. This was at least twelve years ago, and since that eventful period which marked the birth of this great and useful association a healthy growth has taken place, its membership has swelled, and it has assumed a position among the powerful organizations of this country as the representative of its class.

The gentlemen through whose foresight the N.E.L.A. grew in consequence and influence, those that were present at its inception, can never be too well remembered as the first year of the association's existence sinks further and further into the past. The last meeting of the N. E. L. A. was held in New York City, at the Industrial Building May 5, 1896, with Mr. C. H. Wilmerding in the chair. A great electrical exposition was carried on simultaneously with many electrical novelties and new manufactures on exhibition. Speech, or rather the voice of the Falls, was heard in the Hall by telephone; the X rays were allowed to play upon countless hands and a room fitted up by Mc Farlan Moore shed the glories of dawn in the hours of night. The proceedings were opened up by Governor Morton of the State of New York, and for several weeks crowds entered the hall devoted to the N. E. L. A. meetings, and the most satisfactory electrical exhibition ever given in New York city.

The headquarters of the N. E. L. A. have been made

in quite a number of widely separated places in the course of its existence. The following list may be of interest to our friends covering the various steps made by the association since 1885.

Conventions of the Association.

First—Chicago, Feb. 25, 26, 1885.
Second—New York, Aug. 18, 19, 20, 1885.
Third—Baltimore, Feb. 10, 11, 12, 1886.
Fourth—Detroit, Aug. 31; Sept. 1, 2, 1886.
Fifth—Philadelphia—Feb. 15, 16, 17, 1887.
Sixth—Boston, Aug. 9, 10, 11, 1887.
Seventh—Pittsburgh, Feb. 21, 22, 23, 1888.
Eighth—New York, Aug. 29, 30, 31, 1888.
Ninth—Chicago, Feb. 19, 20, 21, 1889.
Tenth—Niagara Falls, Aug. 6, 7, 8, 1889.
Eleventh—Kansas City, Feb. 11, 12, 13, 14, 1890.
Twelfth—Cape May, Aug. 19, 20, 21, 1890.
Thirteenth—Providence, Feb. 17, 18, 19, 1891.
Fourteenth—Montreal, Sept. 7, 8, 9, 10, 1891.

View of Horseshoe and Rapids above the Falls from the Canadian Side.

Fifteenth—Buffalo, Feb. 23, 24, 25, 1892.
Sixteenth—St. Louis, Feb. 28; March 1, 2, 1893.
Seventeenth—Washington, Feb. 27, 28; March 1, 2, 1894.
Eighteenth—Cleveland, Feb. 19, 20, 21, 1895.
Nineteenth—New York, May 5, 6, 7, 1896.

The twentieth convention is that to be held at Niagara Falls, June 8, 9 and 10, 1897. Some very interesting papers will be read by men distinguished in their various and special lines of work. Since the vast increase in electric lighting and the tremendous spread of electric power over the country in the shape of trolley roads, transmission lines, etc., the importance of these conventions have become more and more evident not only to the technical press and the interests it represents but to the greater masses, the general public, the thousands that each new achievement benefits and in a certain sense exalts. The roar of Niagara, the cry of a stream rending itself with excess of power, leaping a precipice to create at its base a foaming void, is of all places best suited for a

"Rock of Ages."

meeting of engineers whose main subjects of discussion relate so closely to the power thundering at their very feet. Prof. Elihu Thomson will read a paper at this meeting treating of the "Recent Progress in Arc Lighting." Next to Brush there is no name better known in that particular field than Thomson's, none that is the embodiment of such stored experience and radical thought.

The illustrations used in connection with this article are eloquent in themselves. The familiar scene at the falls, the famous cliff from which escapes the streams that

The Whirlpool Rapids.

drive turbines for several large concerns, thus giving them in truth "life and power," and the likeness of many N. E. L. A. representatives are readily rcognized.

The past presidents of the association have in every case left same noteworthy evidence of their executive power upon the work performed and progress made by the N. E. L. A. The president of so important an organization is like the pilot of a large vessel; it is in his power to guide the boat through the safest waters, to bring it

S. M. Hamill, V. Pres. Brush Elec. Co. — Elihu Thompson, Gen. Elec. Co. — Edwin J. Houston, Author and Expert. — H. H. Brooks, Am. Cir. Loom Co.

C. O. Baker, Jr., Master of Transportation. — F. S. DeRonde, Standard Paint Company.

W. A. Rosenbaum, Patent Expert. — A. Kennelly, Author and Expert.

C. R. Huntley, Ex-Pres. N. E. L. A. — E. H. Johnson, Pres. Interior Conduit Co.

W. L. Candee, Okonite Co.
J. P. McQuaide, Nat'l Conduit & Cable Co.

C. H. Wilmerding, Ex-Pres. N. E. L. A.
W. J. Godfrey, Habirshaw Wire.

F. Nicholls, Pres. N. E. L. A.
E. F. Peck, Ex. Committee.

Geo. F. Porter, Sec. N. E. L. A.
C. D. Shain, Siemens & Halske.

J. A. Seely, Chair. Ex. Com. N. E. L. A.
H. L. Shippy, Roebling Sons & Co.

Popular Faces at the N. E. L. A. Convention

to a fair haven, and to gain by his skill the respect, admiration and, best of all, the confidence of his passengers. The N. E. L. A. is a craft of growing dimensions; only the best of pilots have served their worthy terms of office and in every case they and the association have been mutually honored.

Presidents of the Association.

James F. Morrison,	of	Baltimore.
Samuel A. Duncan,	"	Pittsburgh.
Edwin R. Weeks,	"	Kansas City.
Marsden J. Perry,	"	Providence.
Charles R. Huntley,	"	Buffalo.
James I. Ayer,	"	St. Louis.
Edward A. Armstrong,	"	Camden.
M. Judson Francisco,	"	Rutland.
C. H. Wilmerding,	"	Chicago.

The executive in office at present is Frederic Nicholls, who will open the proceedings at the International Hotel at Niagara by an address to the convention delegates.

There are many world-renowned scientists, honorary members of this association, Thomas A. Edison, Lord Kelvin, Nikola Tesla, being amongst the number. Upon the list may be noted the names of Prof. I. Fujioka of Tokio, Japan, Baron Alphonse de Rothschild of Paris, and Marcel Depréz.

At the last meeting many important subjects were considered by the Associaton; on this occasion much of the spare time will be devoted to visits to places of interest. The great power houses, aluminum works, etc., will be included.

The picturesque scenery, which can be fully viewed by a ride in the electric cars of the Niagara Falls and River Railway will impress itself in all its wild beauty upon the novitiate.

The seething cauldron where the water of four inland seas tosses with headlong fury over the rocky cliff has been described by poet and musician.

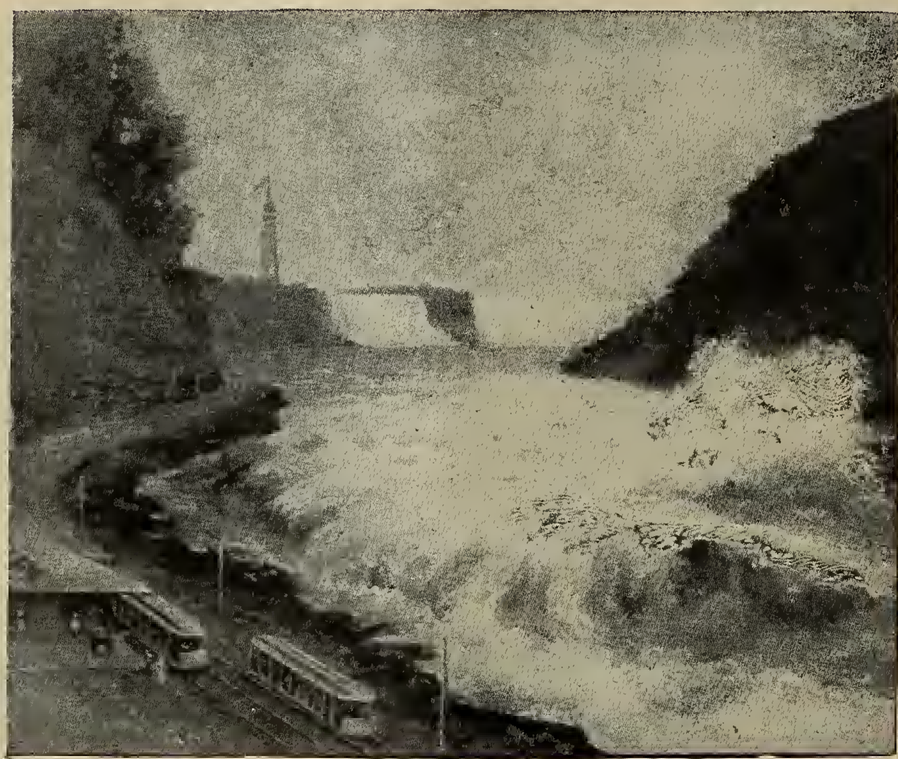
The Indian of the long-forgotten days saw in the leaping waters a mighty spirit; this spirit we are chaining to long hours of toil, guiding its wild efforts to purpose, leading it to labors that glorify our civilization.

We beg to state that the management of the International Hotel has changed hands. Mr. S. A. Greenwood is at present in charge, and not Mr. Horace Fox, as mentioned in last week's issue, May 29.

POWER FROM NIAGARA FALLS.

The 16th of November, 1896, marks an epoch in the history of Buffalo and one in which the whole manufacturing aspect of that busy city within a short time may be metamorphosed. One minute after midnight, with the closing of five sets of switches the power from the cataract at Niagara was brought into the city of Buffalo.

The history of the generating station of the Niagara Falls Power Co. is already so well known to our readers that we will not refer to it except to say that the three great two-phase generators are all in use furnishing power



Whirlpool Rapids, Showing Electric Railway.

to the factories in and immediately around Niagara. The most recent addition to the power house equipment is one of the General Electric Company's converters to take the two-phase current from the generators at 2,200 volts and turn direct current into the lines of two or three railroad companies at a pressure of from 575 volts to 600 volts.

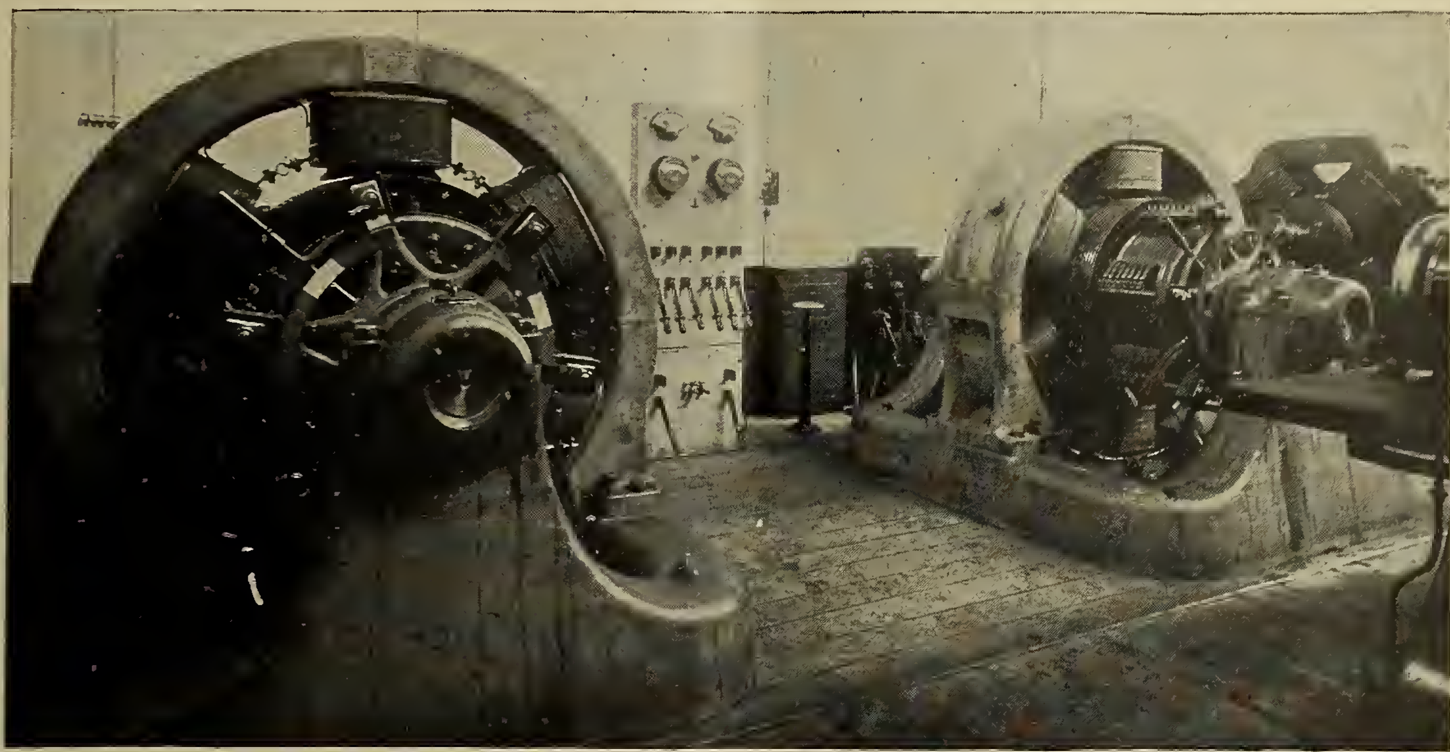
When the question of the transmission of power from Niagara to Buffalo was under discussion, the merits of the three-phase system as compared with the two-phase system for transmission purposes were canvassed. It was shown to the satisfaction of the Power Company that, in using the three-phase system for transmission, a large economy could be made in the transmission installation, and the three-phase system of the General Electric Company was selected.

The current from the Falls is generated by the Niagara Falls Power Co., which transmits the power as far as the city limits of Buffalo. All the construction work in connection with this installation was effected by the Cataract Construction Company, while the distribution, after it has reached the city limits, is in the hands of a sub-company entitled the Cataract Power & Conduit Co.

The two-phase current, starting from the generators in the power house, is led first to the switchboard and then in lead-covered cables through the covered "Bridge of Sighs," which passes over the canal of the Niagara Falls Power Company to a spacious transformer house which has been erected on the opposite side of the canal. Here the cables are connected to four switches on a blue marble switchboard. From this board they pass to the step-up transformers, the largest in the world, erected on a platform at one end of the power house and placed over an air-tight chamber. Each has a capacity of 935 K.W., or 1,250 horse-power, and stands ninety-four inches high, on a base sixty-four by fifty-six inches, and weighs 25,000 pounds.

The problem of cooling these transformers has been solved by driving a blast of cold air up through the air passages provided in the core and coils. The blast is furnished by a large blower driven by a five horse-power multipolar motor, which is belted to it. It is in these transformers that the two-phase system is abandoned and the current given three-phases, and raised from 2,200 volts alternating to 11,000 volts. Provision is also made in these transformers for raising the voltage to 22,000 volts as soon as higher pressure shall have become necessary.

From the transformers three cables pass to the high tension switchboard standing beside them. This switchboard is also of marble, and carries three high tension switches, each switch being separated by a marble barrier about one inch thick. This partition prevents arcing from switch to switch at the high pressure used. The switchboard also carries current indicators and three special fuse carriers. From the transformer house the wires pass through lightning arresters to the first pole of the pole line standing immediately in the rear of the building.



Rotary Converters, Buffalo.

The pole line erected by White, Crosby & Co. runs along one side of a special right of way thirty feet wide. The number of poles in this line is about 21,000; they range from thirty-five to sixty-five feet in length and are set about seventy-five feet apart. Each pole is provided with two twelve-feet cross-arms for the transmission line, and one small cross-arm for a telephone line. Each side of each cross-arm has space for three pins to carry three insulators, provision being thus made for four circuits of three wires apiece; the capacity of each circuit being 5,000-H.P. at 11,000 volts pressure, and 10.000-H.P. at 22,000 volts pressure. On the outside of each upper cross-arm is a small iron pin, eighteen inches high, which serves to carry a galvanized barbed wire used as a light-

Step-up Transformers, at Niagara.

ning conductor and connected to the ground at the foot of every fifth pole.

The insulators used are of the double petticoat pattern. Each weighs about twelve pounds and is provided with two annular grooves in the bottom, which effectually prevent any moisture getting to the central pin on which the insulator is placed. The outside of the insulator is provided with a gutter running to a point on each side to carry off the water. These insulators were subjected to a rigid test of 40,000 volts alternating, to determine the electrical resistance, and not until they had withstood this pressure satisfactorily were they accepted.

The length of the line is twenty-six miles. The overhead conductors are of bare, stranded copper, each conductor having a diameter of 350,000 circular mils., and each lies in a groove at the apex of the insulators. When the line approaches the station at Buffalo, which it does along the banks of the Erie Canal, it is changed from overhead to underground, the wires passing from the last pole into a small brick terminal house. In this house, connections are made with the underground cables through lightning arresters. The underground cable is rubber covered and sheathed with lead, and is of the same diameter as the overhead conductor. It is laid in a subway consisting of vitrified tile ducts, each duct having a hole three inches in diameter. The subway consists of twelve of those ducts, laid eighteen inches below the surface of the ground, and surrounded on all sides by four inches of concrete. Three ducts only are in present use. The insulation of these cables was tested to withstand 80,000 volts.

The subway terminates in a small brick structure erected in the rear of the Niagara street power house of the Buffalo Railway Company. This contains the step-down transformers. On entering this small house, the wires are connected to another switchboard carrying high voltage switches and fuse carriers separated by partitions of marble in the same manner as on the high tension switchboard at the Niagara Falls end of the transmission. From this board, cables are carried through lightning arresters to the transformers, of which there are three, two being in use and the third being held in reserve. Each weighs 7,000 pounds, is eighty-two inches high with a base measurement of forty-seven by thirty-six inches. In the step-down transformers, the pressure is reduced from 10,700 volts to 370.

A system of cooling the transformers similar to that used with the step-up transformers at the Niagara end is used.

From the step-down transformers, the three-phase current, divided into two circuits, passes over six cables to the main floor of the power house of the Buffalo Railway Company, where they are connected to another switchboard. Thence they pass to the two rotary converters, each of 500 H.-P. capacity. These converters are six-pole machines, and in their operation, the three-phase alternating current at 370 volts is changed into direct current at 500 volts, suitable for delivery to the feeder line of the electric street railway. Each converter armature is provided with three collector rings at one side and a commutator at the other, and may be started either by the alternating current or by direct current from the railway lines. The converters may be used in parallel with the other generators, or the current can be thrown directly into the feeders of the railway system.

The lightning arresters of the Wirt type have been especially designed for heavy voltage transmission work and are single pole. They consist of strips of marble upon which are mounted eleven cylinders, giving one air gap space one thirty-second of an inch for each thousand volts, with an allowance of twenty-five per cent. rise in the potential. In the action of the arrester, the large metal cylinders serve to chill the arc so that, on reversal of the current, the arc is extinguished, no dependence being placed upon any non-arcing property of the metal to put out the arc. In order to limit the current on short circuit, and thus the heating effect, a special solid graphite rod of low non-inductive resistance is used. The arresters are similar to those used on the Big Cottonwood transmission at Salt Lake City, which have effectually protected the machinery in many severe storms, and are now being used extensively in transmissions where high voltages are employed.

The entire apparatus used in the transmission of the current from Niagara Falls to Buffalo is from the shops of the General Electric Company, having been designed especially for this special service.

LECTURE ON "THE DIRECT CONVERSION OF HEAT INTO ELECTRICITY."*

President Emery introduced Mr. Cox, who said:

Mr. President and Gentlemen: I have to apologize at the start for the incompleteness of this lecture, but my neglect of it has been due to my ill-health since I returned from England. I think that the change of climate was what affected me, but I really have been seriously ill and unable to give this lecture the attention it deserves. My ill-health has not, however, affected the action of the machines I am going to show you this evening.

It may interest you, perhaps, to know how I came to take up the subject of thermo-electricity. Thermo-electricity is a much tabooed, much maligned and much misunderstood subject. People think that immediately one takes up the problem of thermo-electricity that it is not exactly a guarantee of the healthy condition of one's mind. I have been studying the subject for a great many years, and I do not know but that it has affected me. I think it will interest you to know that I took up the subject from reading a newspaper clipping when I was but a young boy. I saw the clipping, I think, in "Harper's Weekly," or "Bazaar." The clipping was this: "There are three great inventions to come—the first is the direct conversion of heat into electricity; the second is a light without heat, and the third a successful flying machine."

I concluded that the greatest of these problems was the direct conversion of heat into electricity, and immediately I took up the work with the courage and confidence of youth, little dreaming of the years of hard work before me.

It may amuse you to know what means I first tried, with the view of producing the result which I desired. I will illustrate to you on this blackboard the way in which I tried to produce electricity by what we know as thermo-electricity, or the thermo-electric effect. In other words, electricity directly from heat by thermo-electric action. First, I went to the Cincinnati public library and got a text-book on electricity, and read it very carefully, and from the deductions which I made from the statements of the text-book regarding the subject I concluded it was simply a question of bringing two metals together somewhere or somehow, and if heat was applied to the metals someway or somehow, that the effect desired would be produced. I concluded to make a machine and try it—that if nobody else had succeeded in producing such a machine that of necessity I certainly could, there being no doubt about that. I started with the firm conviction I could do it and was going to do it. The idea that came into my mind was to have two dissimilar metals so that they did not touch and yet apply heat to them. I then got up a machine in this way (illustrating). Here are two disks of metal and here is a piece of insulation between. My conception was that I wanted as fine a piece of insulation as I could get. Here was another disk of metal that was insulated from the others. Then I put another piece of metal with another insulating disk below. Then the fourth piece of metal was insulated in a

* Delivered before the New York Electrical Society, Thursday, May 20, 1897, by H. Barringer Cox.

The Electrical Age.

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CONTENTS.

SEEING ACROSS THE ATLANTIC OCEAN.

Americans will experience the unique pleasure of seeing the Queen's Jubilee take place. They will by the aid of science gaze upon faces and forms moving with all the similitude of life, yet by magic art brought to the very threshold of their homes. They will view a great pageant, its struggling onlookers, its martial trappings, its slow procession through multitudes in the very heart of England. This they will see in all realism transplanted across the broad bosom of the Atlantic to the metropolis of the United States.

There is no greater triumph to be recorded on historic pages than this wonderful event. In the Mail and Express of May 24 an account is given of the arrangements being made to secure and transport scenes of the Jubilee.

It will take but fifteen days for the people of San Francisco to see revived into deceptive animation scenes that to many participants had become but a cloudy recollection. In one day after being taken the films used in this improved biograph will be ready for shipment across the ocean. In this manner great national events can be recorded, and years after, possibly when many of the chief actors have passed away to the land of shadows, science will breathe a cold, automatic life into them and call them forth like wholesome spectres to play their parts and make their exit. To those that have not seen the flying train depicted, the Empire State express rushing forward at the rate of sixty miles an hour, we advise immediate observation.

This train rushing forward to the accompaniment of a bell which strikes with increasing vigor has never failed to make the orchestra rows rise in involuntary fright. The delusion is perfect and the awakening brings out a burst of applause.

When life-like sounds accompany the picture, distance seems annihilated; the surroundings are forgotten and the beholder lives momentarily in the shifting scenes passing before him.

SOME CURIOUS PROPERTIES OF INSULATORS.

There is no dividing line to be drawn between the insulator and conductor, except in a relative sense. The mechanism of conduction has not yet been clearly analyzed or understood. It is sufficient for us to say that a great class of materials can carry electrical energy from point to point with varying degrees of ease; that others do not naturally possess this property and therefore noticeably fail in the undertaking. It is on a basis similar to this that a general classification has been made dividing the conductor from the partial conductor and insulator.

The effect of a sustained pressure upon an insulator is such that it breaks down in the course of time under the strain.

To those interested in the phenomena associated with high potential experiments this gradually decreasing power of resistance in fairly good insulators has received considerable attention. An insulator "fatigues" under the influence of a high pressure and acts as an organism would, striving for life in the midst of conditions that are ultimately fatal to its existence. A sudden pressure applied to a given insulator will be successfully resisted for quite an interval, but then a weakening occurs and the material slowly deteriorates and ruptures. The effect of a pressure that alternates is noticeably severe upon insulators that would be capable of standing the test well with a uniform pressure.

In all probability the alternating pressure causes heating in the insulator due to "dielectric hysteresis." The insulator in that case becomes ruined and unsafe. The transmission line stretching from Niagara to Buffalo was affected in this manner, some of the insulators failing to perform their functions as non-conductors.

The insulating power of a given material and its natural property of transmitting inductive action deserve, on all occasions, separate attention. They do not seem to bear any relation to each other. A good insulator may have a high specific inductive capacity. A poorer insulator a lower capacity, etc.

Mica has a resistance of eighty-four million ohms per cubic centimeter and an inductive capacity of five as compared with air. Olive oil has a resistance of only one million ohms per cubic centimeter and a specific inductive capacity of 4.78.

Thus, there are properties to insulators that outline to us new and interesting probabilities regarding the relation they bear to the conductor, and the influence of high potentials under continued strain.

The Cutter Electrical and Manufacturing Co. of Philadelphia, announce that they have opened an office, in charge of Mr. H. B. Kirkland, in the Beard Building, 120 Liberty street, New York City.

No stock of any kind will be carried in this office, but the extensive line of
I–T–E Circuit Breakers and C–S Switches will be on exhibition.

Mr. Kirkland will be pleased to extend to his friends and the electric trade generally the facilities of this office, and a continuance of your esteemed patronage is requested.

Owing to the press of new matter the article on the Synchronograph, as well as the Lesson Leaves, have been discontinued this week to appear as usual in next week's issue.

similar way, and so on, building up my pile until I had quite a lot of disks. I had a strong conviction that the chief idea in thermo-electric work was to use dissimilar metals, and apply heat properly, and then we had the problem solved. I made up my mind not to get metals that someone knew about, because in that event my prospective patents might be defeated, so I very carefully instructed one man to make one metal disk, and went to another man and got him to make the other one. After I got the pile arranged all right—built up as shown—up through the centre of it I placed the heating device, which was an ordinary argand lamp burner, that was to heat the metals. My conception of the problem was simply to have two dissimilar metals someway or other heated ; so, after I had my argand burner, with the pile surrounding it, I carefully took off a wire from there and here (illustrating) and then looked for results. Now, if there had been any attainable results from the thing I never would have found it with the device I had to indicate the current. I had been led to believe that all you needed to indicate electrical energy was a compass with a wire running underneath it, in which there flowed an electrical current. So I took an ordinary compass and run a wire underneath it, and with my pile in circuit I carefully watched for the deflection. I did not find it then and I would not expect to find it now with such a combination of devices (laughter). I had carefully insured against every possibility of effect ; it was impossible to get any. That was my start in direct conversion, and I think you will agree with me that it was enough to discourage even a youth.

(To be continued.)

ANNUAL MEETING OF THE NEW YORK ELECTRICAL SOCIETY.

The New York Electrical Society held its annual meeting on Thursday, May 20th. The officers elected were, President, Dr. M. I. Pupin ; Vice-Presidents, Gano S. Dunn, Max Osterberg, W. W. Ker, A. L. Riker, Willard E. Case, H. B. Coho ; Secretary, George H. Guy, Treasurer, Henry A. Sinclair. The society has now 397 members. The president read a letter from the treasurer, in which was stated that a large number of members had failed to pay their dues. The president urgently requested that these arrears should be remitted forthwith, as the society, while in good financial condition, has plans for extended work for next season, the carrying on of which will be impossible without proper funds. After the disposal of the business part of the meeting Mr. H. Barringer Cox lectured on "The Direct Conversion of Heat Into Electricity," showing the present conditions of the practical relations between heat and electricity, in regard to the direct conversion of the energy of fuel into current.

Following up the meeting which has attracted so much attention, at which Mr. Case experimented with his carbon consuming cell, Mr. H. Barringer Cox, who for many years has been working on the developments of thermopiles, gave a very interesting lecture, which he illustrated with three of his thermo-electric generators, using gas flame as the source of heat. These generators consist of a number of thermo-electric couples of ingenious construction, grouped circularly around the flame, in which hangs a deflector, or series of baffle plates. The elements are encased in fire resisting clay, backed up by a metal case, which forms the water jacket. From this small contrivance, which is about half the size of a silk hat, sufficient output is obtained upon the consumption of 2½ feet of gas per hour to run a small ordinary fan motor, or to operate such devices as electro-medical circuits, telegraph keys, X-ray apparatus, gongs and other devices.

There was an animated discussion which was participated in by Dr. Emery, Dr. Crocker, Dr. Pupin, and Messrs. Mailloux, C. S. Bradley, Sachs, Ward Leonard, Lieb and others. Mr. Gano S. Dunn made the readings in testing the operation of the thermopiles, as there was a brisk dispute as to what the theoretical and the actual output of such devices ought to be.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.) SOLDER FOR ALUMINIUM.

Niagara, May 24, 1897.

Electrical Age Publishing Co.

Dear Sirs: While attempting some experiments with different metals for the purpose of finding out what will best braze or solder them I found, in my experiments with aluminium, that nothing I could use would adhere to the metal with ordinary heat. I thought this very extraordinary, and inquired at the aluminium works here whether any method existed, but was told that none was known.

Thinking a suggestion from the Electrical Age of value I hereby beg to inquire whether they know of anything ?

Yours respectfully,
R. L. SIGMUND.

(A.) We cannot recommend any combination that will satisfy you. The soldering of aluminium or aluminum is a difficult task and no reason can be given by us why it is not possible. The chemist may operate in this field to advantage, a great demand at present existing for an aluminum solder.

(Q.) DIFFERENTIALLY WOUND MOTOR.

Toledo, May 22, 1897.

Electrical Age.

Dear Sirs: If a differentially wound motor is suddenly stopped what will occur ? I have puzzled over the question quite some time and await your answer with great curiosity. Yours respectfully, Jonah Case.

(A.) When a differentially wound motor is suddenly stopped the series coil, called in this case the differential coil, has a heavy rush of current passing through it, because the back E. M. F. has ceased. The shunt coils remain unaffected, but the effect of the differential winding is to reverse the field, and if the ampere turns of the shunt coils are less than those of the series coil the field will reverse.

(Q.)—LIGHTNING ARRESTERS.

Phila., May 8, 1897.

Electrical Age Publishing Co.

Dear Sirs : Can you give me any information on the following subject ? (1). The general principle of the lightning arrester. (2). The reason why they will not all operate successfully. My experience with them has been such that I cannot always depend upon them, and I think they may be improved in a practical manner so as to be perfectly reliable. Yours truly,

L. Sheehan.

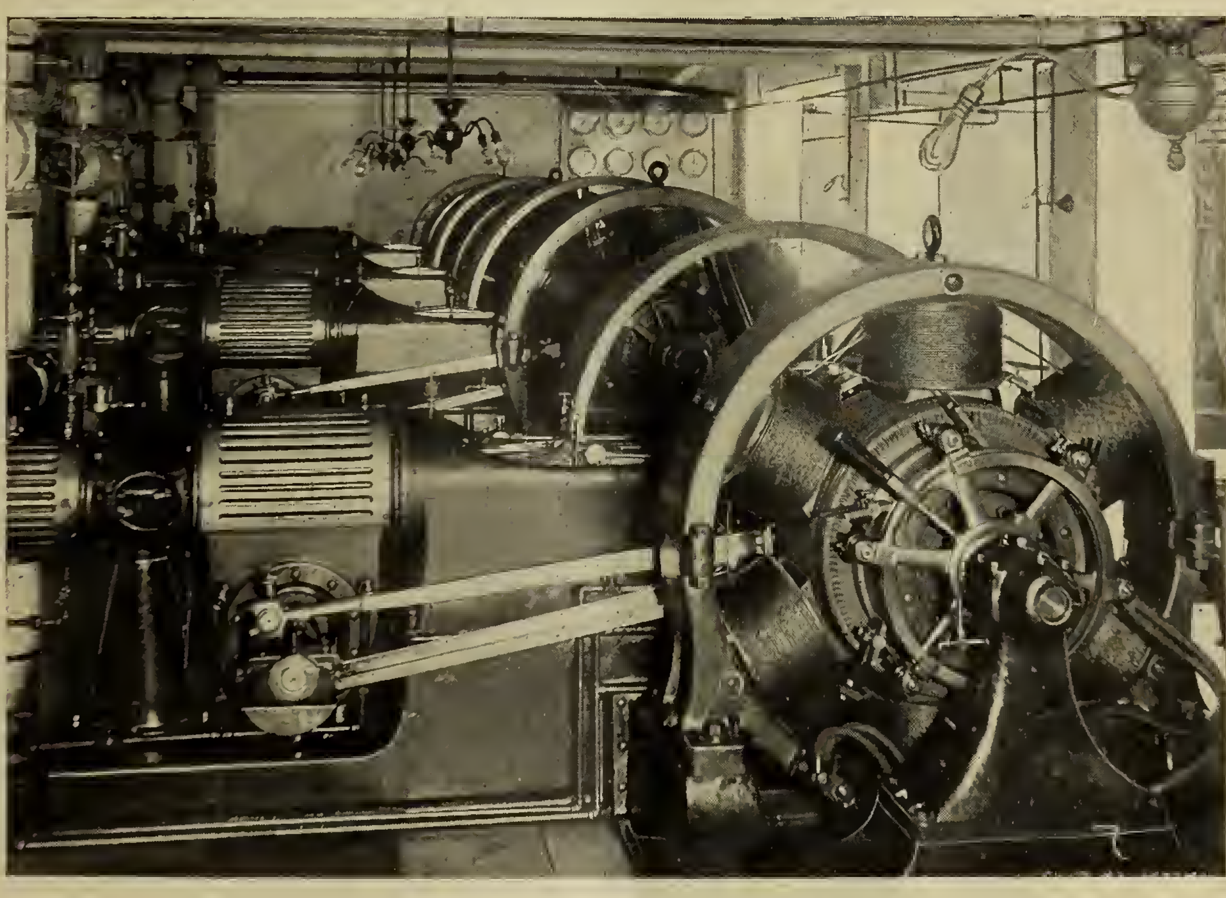
(A.) 1. The lightning discharges have a choice of two paths, one to earth via the air gap ; the other, along the line. The impedance or opposition along the line usually forces the discharge to earth. The choice of paths is determined by the frequency of the oscillations. 2. The greater the frequency the less likelihood of the discharge passing along the line, but the less frequency the greater possibility of the discharge entering the station and destroying valuable machinery. The entire explanation reduces down to the fact that a conductor opposes the passage of a high-frequency discharge, but permits a low-frequency one to pass. Hence the ground connection and the air gap should be arranged to invite discharges of comparatively low as well as high frequency.

TYPES OF AMERICAN DYNAMOS.

The advance every few years in the direction of improvements in dynamos has received considerable attention from the student of electro-technics. The changes that are comparatively recent, in construction and design, have been in the general order of progress. Multipolar types prevail, and slotted armatures; the iron-clad dynamo has found a permanent place and carbon brushes are in common use. The framework of the machine itself is made of steel, and all the advantages of a metal more than eighty per cent. as good as wrought iron, without the disadvantage and expense of being forged, has asserted itself. The shop methods have reduced themselves to a system which leans toward economy and despatch; there is no longer either crudity or uncertainty about the building of a dynamo.

Commercial Electric Co.

A healthy change has manifested itself throughout the entire field of electric lighting. It has been the cause of a myriad of improvements, and has aided American manufacturers in producing machines which for economy and design are fit standards for our foreign cousins to model from. The following represent a few of the standard types manufactured by well-known builders with as much description and attention to detail as space would allow:



Ellicott Square Building, Buffalo. Latest Type of Dynamos for Isolated Plant. General Electric Co.

GENERAL ELECTRIC DYNAMO.

The machinery constructed by the General Electric Company needs but few words from us to further its interests, as the immense plants operated by them for the purpose of manufacturing every available kind of electrical apparatus is world-renowned.

In a plant installed in the Ellicott Square Building, Buffalo, N. Y., four multipolar 30-kilowatt machines were set up. They rotate at 30 revolutions per minute and are direct-driven each by a 50-H.P. Ames engine. In the illustration an idea can be gained of the general appearance of this plant, its engineering finish and businesslike completion.

The building was wired on the three-wire system and the switchboard containing all the connections made of Tennessee marble. A Lundell 10-H.P. motor drives a large blower in the restaurant. The General Electric dynamo frames are made of cast steel, possessing a high permeability. A strong steel shaft supports the slowly revolving armature, which is carefully wound and connected to a somewhat massive commutator.

The corps of engineers employed to oversee and introduce innovations in des'gn have been successful in producing a dynamo whose detailed excellence leaves but little to be desired. The armature of this dynamo is able to radiate heat with the utmost facility. In consequence thereof an overload can be sustained that would be a severe trial to some others of similar construction. A toothed armature, into each slot of which the inductors are carefully fitted, supplies a feature of great mechanical and electrical value. Sparking and heating of the commutator rarely occurs; thus, as may be seen, all the functions a good dynamo is supposed to perform are being faithfully executed in the General Electric generators.

THE LUNDELL DYNAMO.

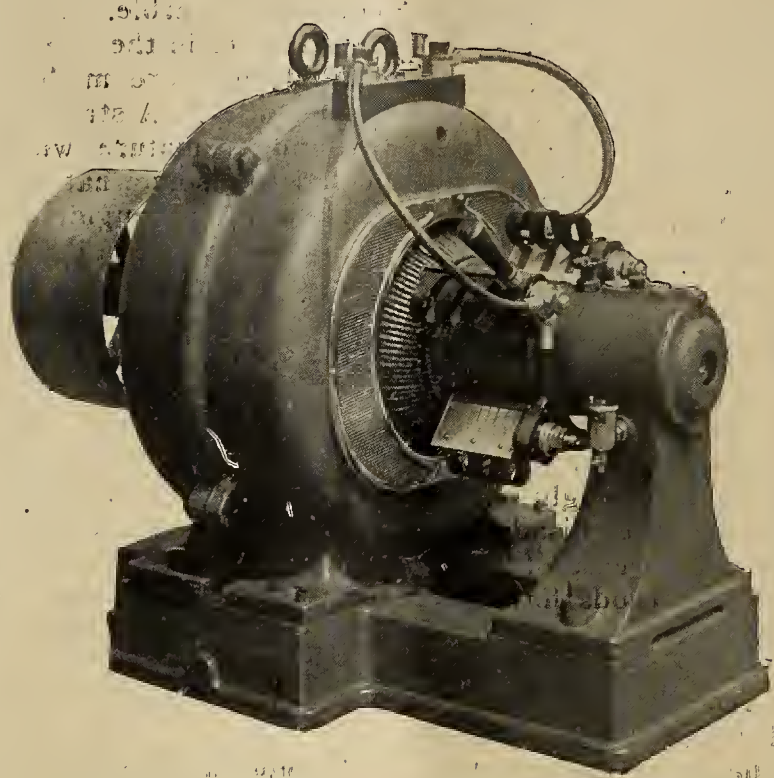
Among the manufacturers of up-to-date machinery of high efficiency and known reliability the Interior Conduit and Insulation Co., of 527 W. 34th street, New York, occupy a position of considerable prominence.

The Lundell Dynamo manufactured by them and represented in the illustration is built on the best scientific principles. It combines within itself the elements of design that contribute toward the best construction and most efficient operation. In the illustration is represented the latest type of Lundell dynamo. The machine is iron-clad, thus protecting all internal parts from injury or abrasion. The cross section of the field cores is of sufficient size to not only provide a strong field but to allow of a surface radiation for the coils which keeps them cool. A solid steel shaft prevents any possible vibration of the armature, and bearings which are self-oiling and self-aligning secure the most important mechanical features.

The bearings never heat, due to the three essential requirements of a good dynamo, a well-balanced field, a perfect lubrication and alignment.

The armature is carefully wound, being of the slotted type, each slot carefully insulated and the wire fitting the commutator. These dynamos can be direct-connected or driven separately as desired.

They combine some of the best features, such as will lead to excellent service in practice and the confidence of the consumer at all times.

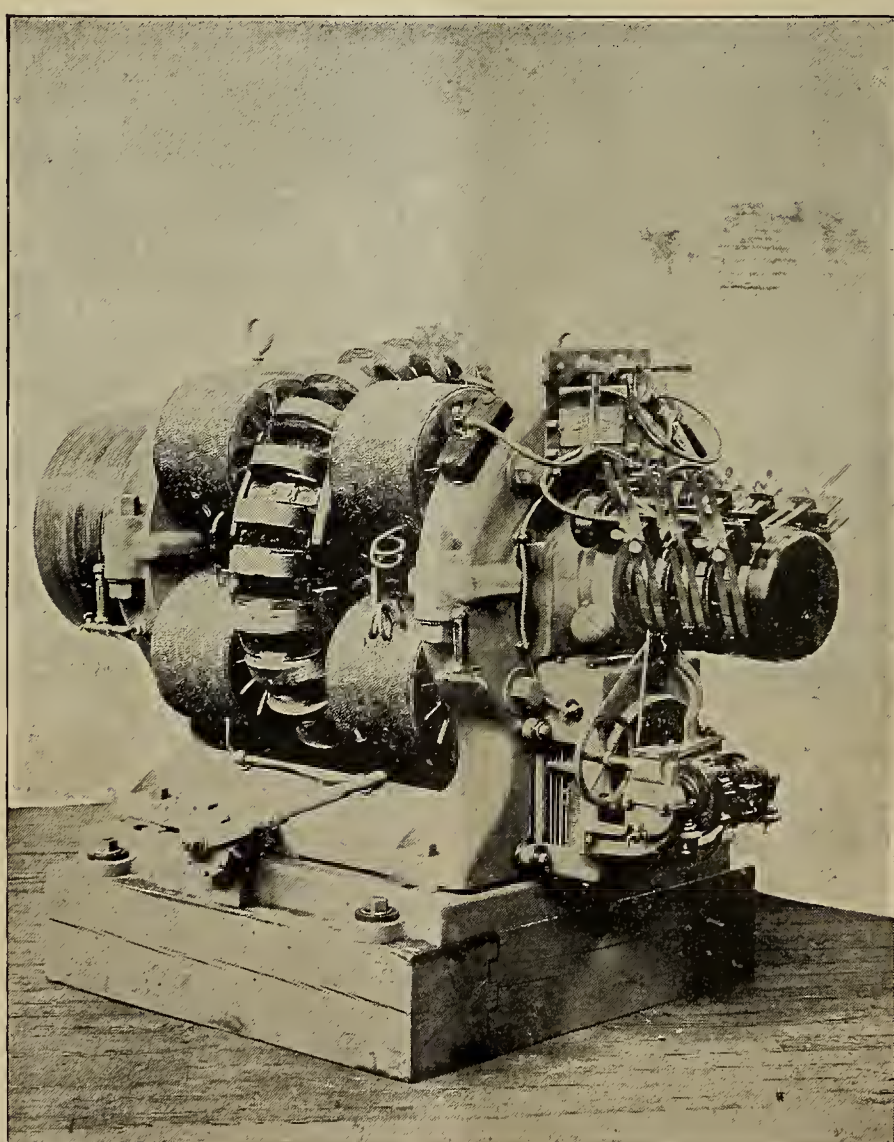


Lundell Dynamo.

tightly in place. A large surface of radiation keeps it cool at normal speed and allows it to stand quite a percentage of overload without danger. The commutator is large and of sufficient cross section to provide excellent conducting surfaces.

BRUSH ARC DYNAMOS.

The first Brush arc dynamo was made and sold in 1877. Since then twenty years have passed and thousands of Brush arc dynamos and lamps are used in every country

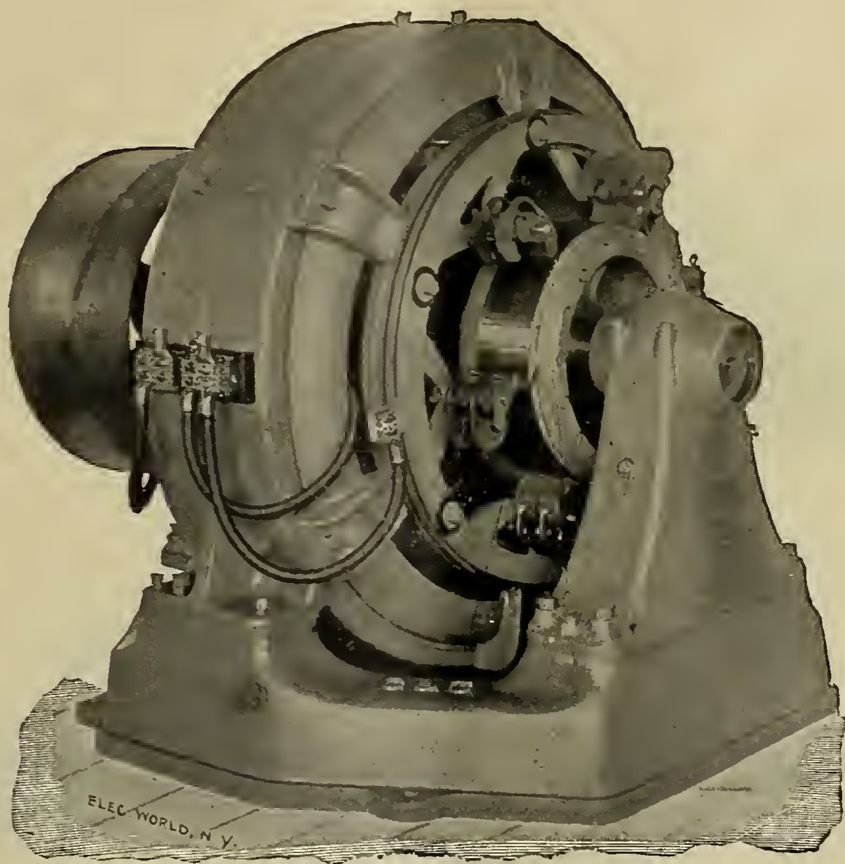


Brush Multi-Circuit Dynamo.

The brushes press firmly upon it without clatter or unusual friction. The surface of contact between segment and brush being large, therefore preventing any heat at

in the world. The Brush Company have kept abreast of the times in the development of their arc system and the multi-circuit dynamo which they have placed on the mar-

ket during the past year has met with great success. A large number of them have been sold wherever central station men or parties running isolated plants want more floor space, increased efficiency, and have an eye always watching for a reduction in expenses. These advantages can be secured by substituting large Brush arc dynamos designed 80-light and 160-light. All of the machines are of the multi-circuit type. Three or four circuits will be run from the 300-lighter. The widespreading success the Brush Company have met with in the sale of their arc light machinery is universally known. Their address is Schenectady, N. Y.



C & C. Dynamo.

for smaller units. The problem of not changing their circuits is met by the divided circuits of the machine. A party with fifty lights on a circuit and running two circuits from two small machines can run the same two circuits by replacing the two machines with one large new arc machine divided into two circuits without necessitating any changes in the circuits.

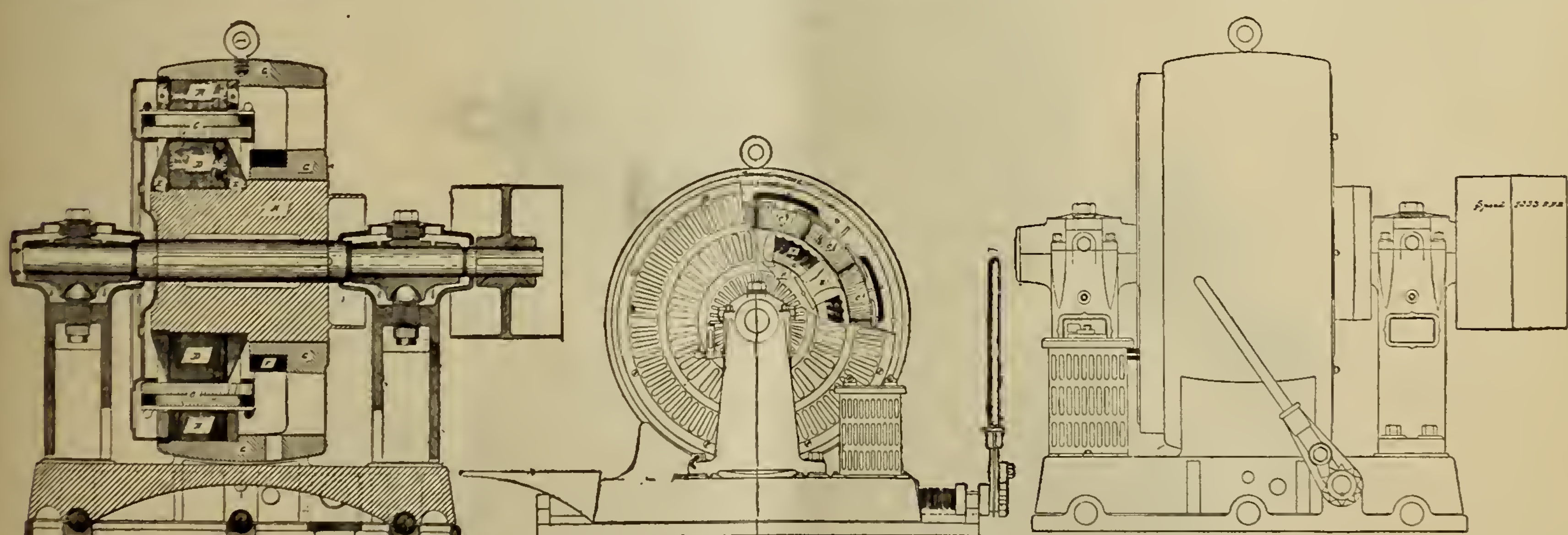
John Wanamaker, in his store in Philadelphia, exchanged twelve small dynamos ranging from sixteen to sixty-five lights and replaced them with five 125-light dynamos each running two circuits of sixty-two lights each. The Carnegie Steel Company did the same thing at their great works at Bessemer, Pa. Eight of these divided circuit machines have recently been installed in the electric light station at Newark, N. J. Eight more of them will soon be erected in the electric light station at Worcester, Mass.

The Brush Company have on the market an 80-light, 100-light and 125-light, 2,000-candle-power arc dynamo, and are just about completing a 300-light, 2,000-candle-power Brush arc dynamo. They have a 120-l'ght, 1,200 c.-p. arc dynamo, and are just about completing a newly-

C. & C. MULTIPOLAR GENERATOR.

The demand has gone forth for well-constructed, efficient, slow-speed dynamos. The concerns that have anticipated this cry have prepared for the necessary change in engineering practice the advent of such machines would cause. The C. & C. Electric Co., of 143 Liberty street, New York, were among those sharp enough to see the future of machines possessing these characteristics, and as a result their shops turned out a six-pole generator as illustrated, running at a slow speed, of high efficiency and admirably finished in every part.

The magnetic circuit is of soft steel, the field concentrated around the armature and the coils running cool.


Warren Electric Manufacturing Co.

The brush holder, built on the plan of the "reaction type," special C. & C. design. The armature and commutator are easily removable from the shaft, the commutator being supported by the framework on the armature. The self-oiling bearing and shaft that is fully competent to bear any strain from the machine completes the sketch. This well proportioned machine is a fine example of American engineering.

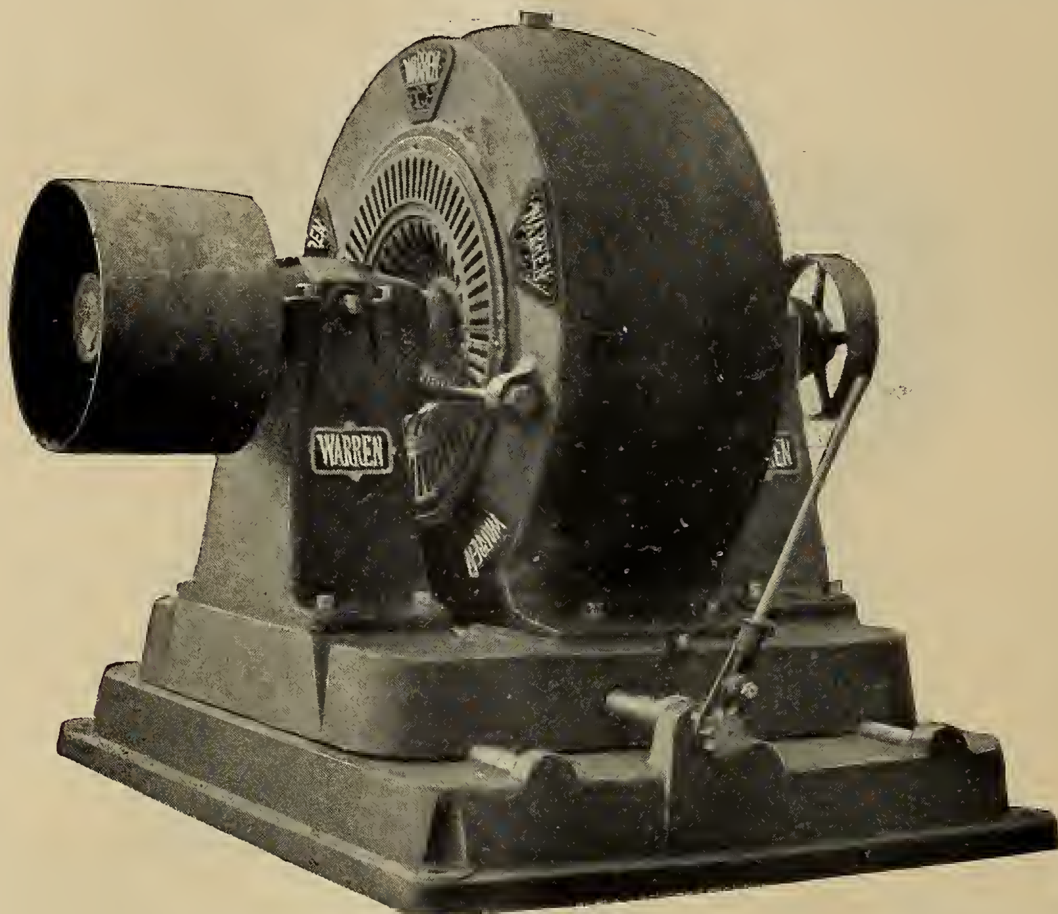
WARREN ELECTRIC MANUFACTURING CO.

In the following illustrations are represented line cuts of the interior of the Warren alternator and photographic reproductions of the same.

The headquarters of the Warren Electric Manufacturing Co. are at Sandusky, Ohio. They have started out with the evident intention of making an alternator that will do its work effectively and well. It has been called "the modern dynamo for station work," and the name is deserved.

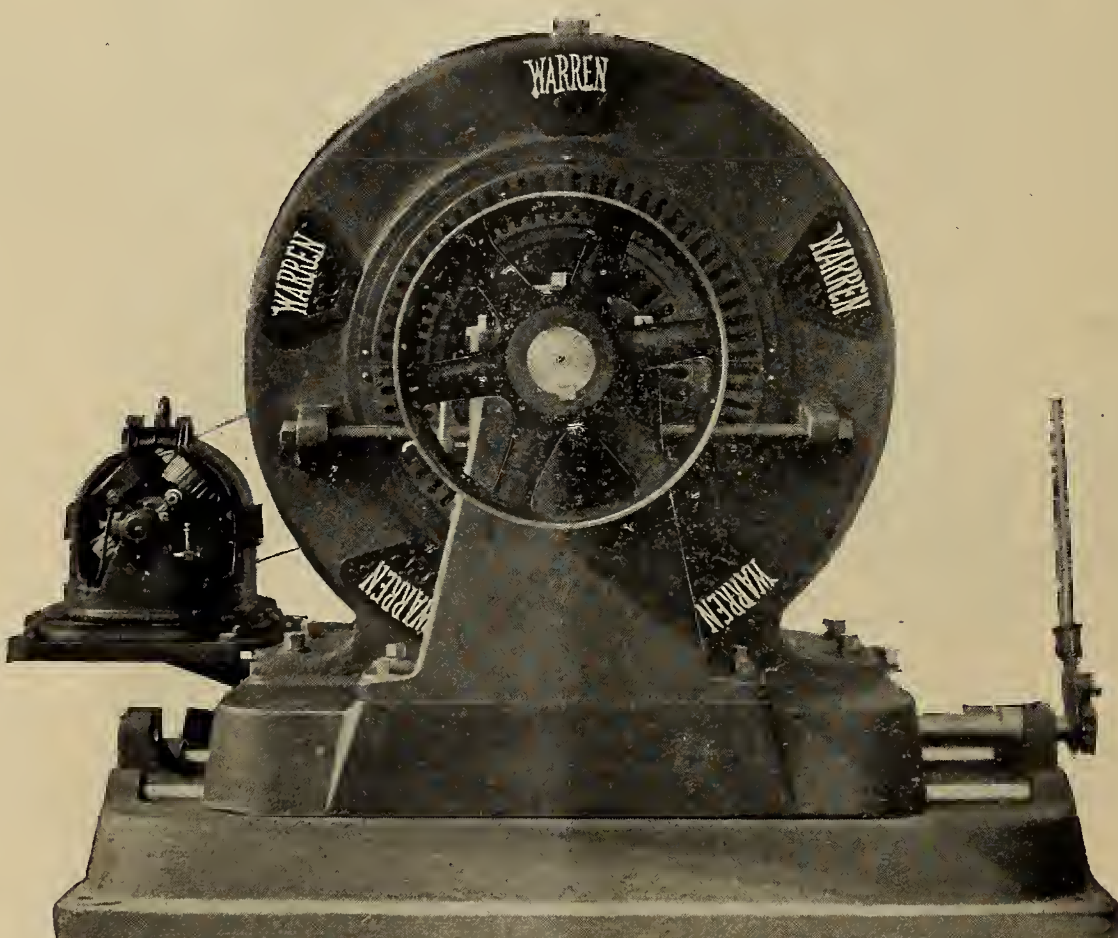
In this dynamo, which is of the induction type, the armature is at rest. This is a great feature in a generator as the banding and labor required to support the armature securely to the shaft is dispensed with. In addition to this great advantage the field is stationary.

The principal features of design embodying these points are represented in the line sketches. The value of these two types of drawings is highly evident; the reader being able by their aid to judge not only of the exterior of the machine but to gain some idea of the internal construction, the parts that mean either long life to the dynamo or "a short shrift."



Pulley End of Warren Electric Manufacturing Ca.'s Dynamo.

The outward appearance of a dynamo is often its selling feature, and this in itself greatly depends upon its excellence of design. A poor architect cannot build a beautiful house; neither can an incompetent engineer design a handsome dynamo. The finish of the generators made by the Warren Electric Manufacturing Co. is in every respect an evidence of care, design and construction.

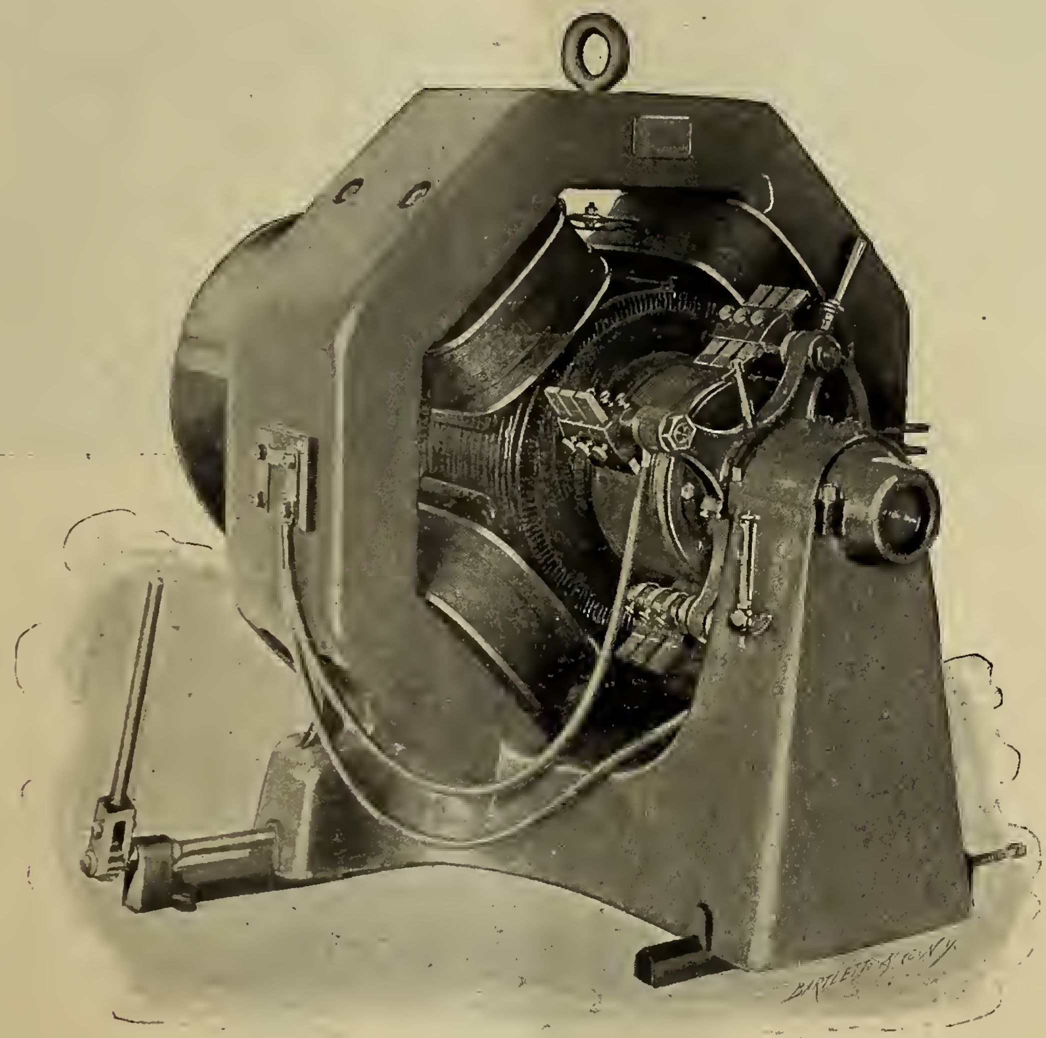


View of Exciter of Warren Dynamo.

With a stationary armature and field, that is, no moving wire, the machine can last indefinitely.

Any voltage or multi-voltage can be obtained; the absence of brushes and a fairly low speed makes it a machine particularly safe and useful. If it were not for occasional lubrication, absolutely no attention would be required. The efficiency of the Warren alternator is high and much care has been paid to the regulation to secure a close uniformity of pressure.

The armature consists of a laminated and ventilated core of sheet iron, mounted on a sleeve which is forced on and keyed to the shaft. The windings are made up of copper rods of rectangular section, embedded in insulated slots in the surface of the core, and spirally shaped copper ribbons connecting them on the ends of the armature.



Eddy Dynamo.

EDDY MFG. CO.

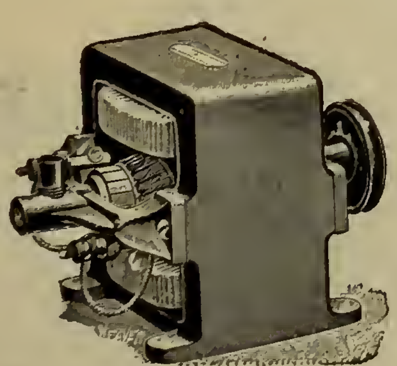
The Eddy Mfg. Co., of Windsor, Conn., are a well-known firm of dynamo builders. Many of their machines are used in the largest hotels and apartment houses of this city. The following description is interesting to the technical reader:

The Eddy, type "G" generators consist of a cast iron octagonal frame, to which are bolted four cast steel poles, with flanging tips. Each pole is excited by a field coil, wound on a metal spool, the shunt and series portions in separate compartments. Each layer of wire is insulated from the next by a sheet of tough paper, and the whole winding is thoroughly insulated from the spool by layers of paper, cardboard and mica.

Cast with the lower portion of the field frame are extensions for supporting the pillow block bearings. The bearing shells are self-aligning and self-oiling, and well babbitted.

The commutator is made up of segments of hard copper beveled on the ends and held in place by collars bolted together. The bolt nuts are secured by an efficient nut lock which simultaneously binds all the nuts. Either tangential or radial holders are supplied with these machines. In either form the brush is held against the commutator by a pressure regulated at the will of the attendant, and in such a way as to prevent rattling and jumping.

The Eastern agent is H. B. Coho, St. Paul Building, New York.



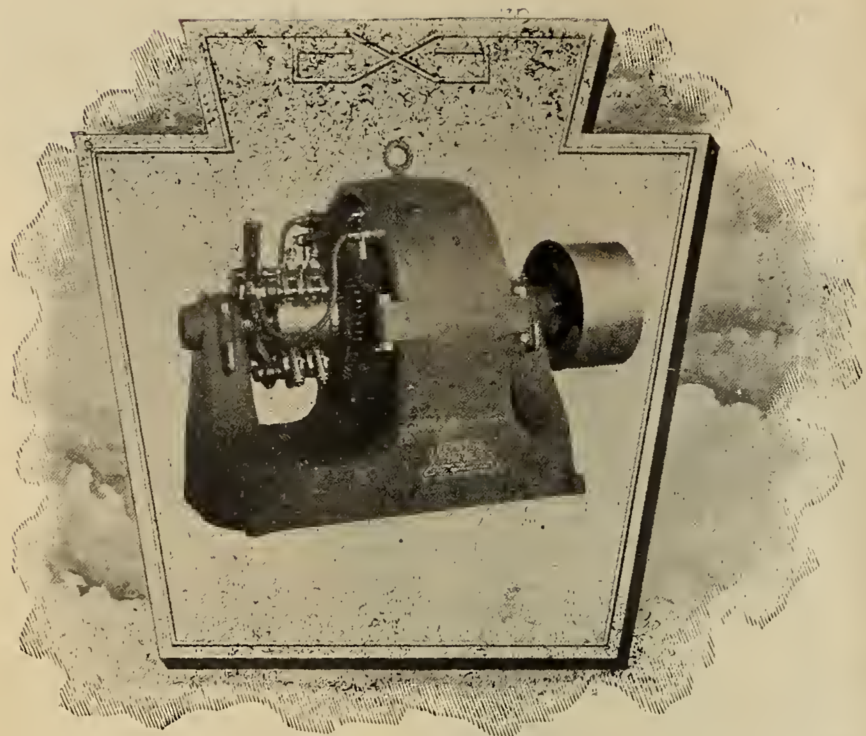
Type K.

Type B.

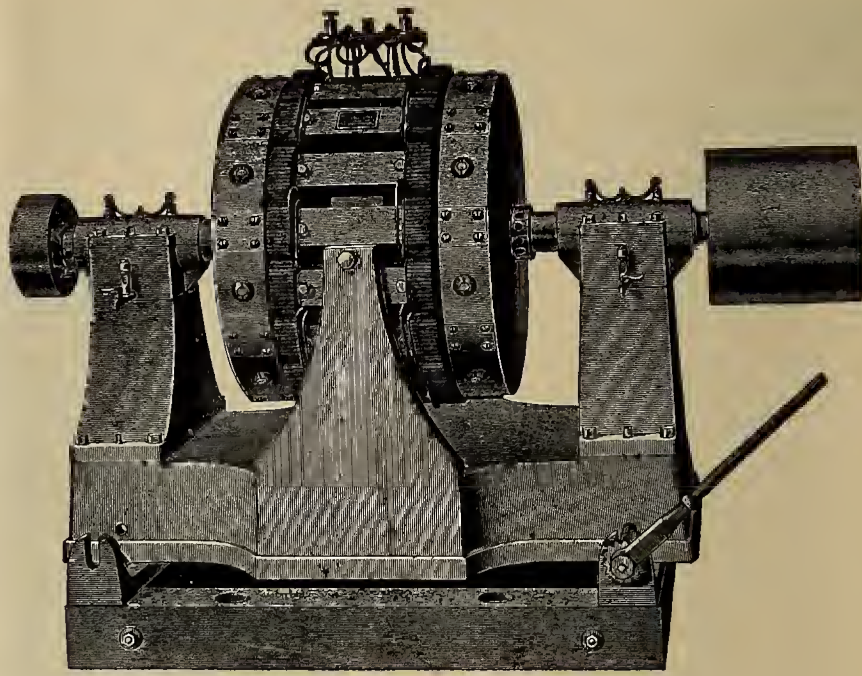
Elbridge Electrical Manufacturing Co.

THE ELBRIDGE ELECTRICAL MANUFACTURING COMPANY.

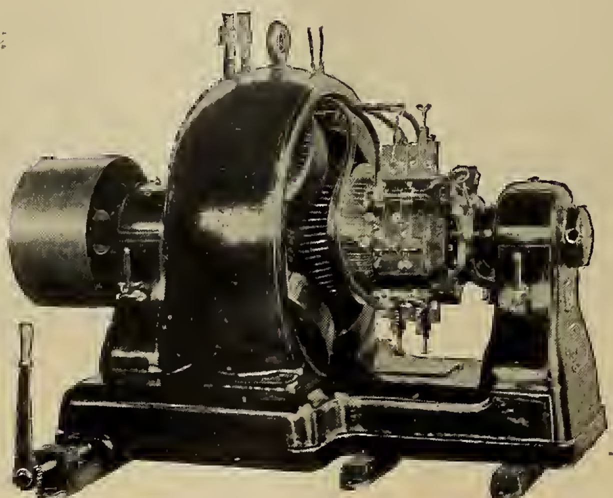
The Elbridge Electrical Manufacturing Co., of Elbridge, N. Y., was established in 1891, beginning with the manufacture of experimental school apparatus, which is now in use in many of the best schools and colleges in the country.



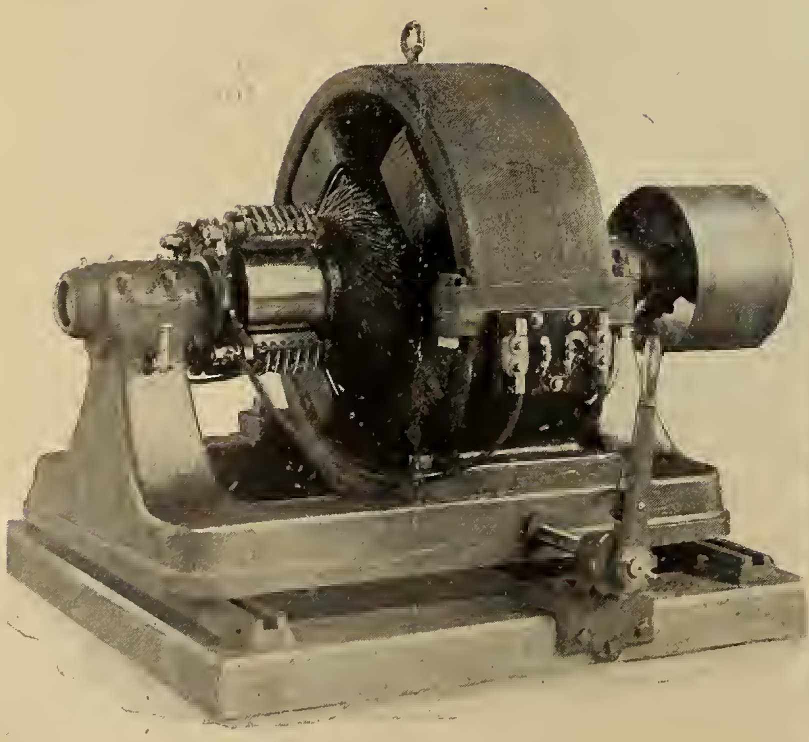
Keystone Electric Co.



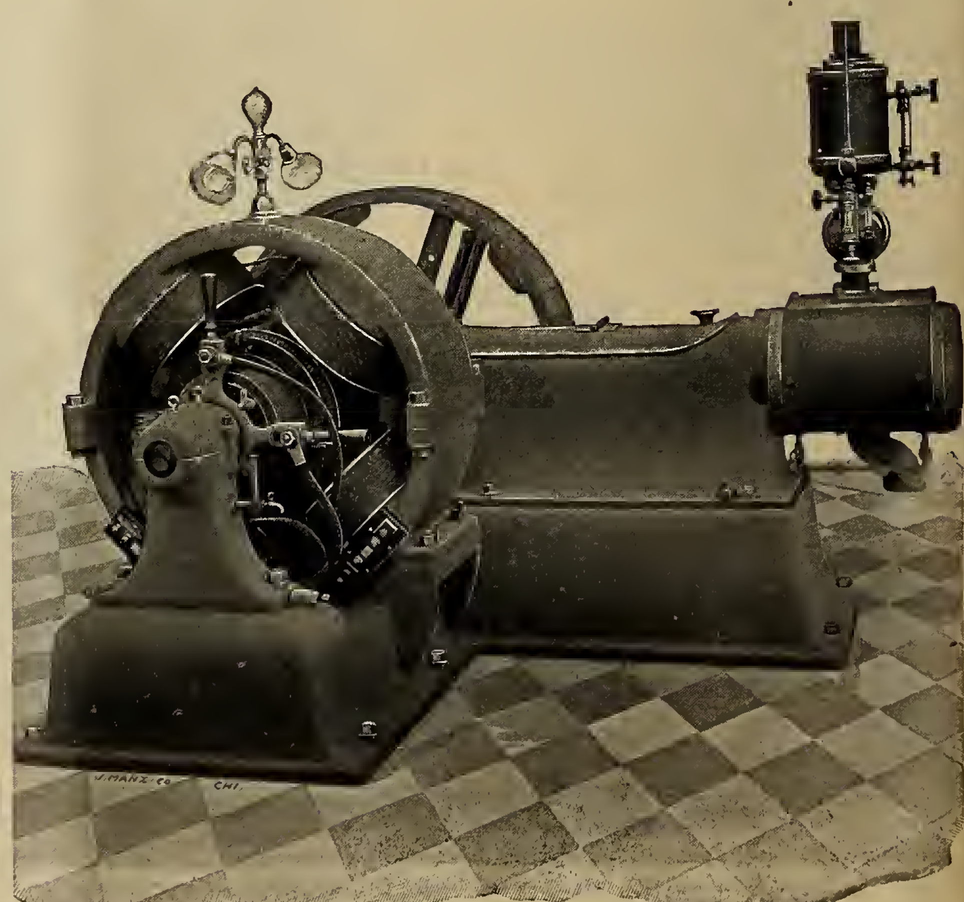
Royal Electric Co.



Card Electric Co., Mansfield, Ohio.



Elektron Manufacturing Co.



Commercial Electric Co.

Their type B was designed for a cheap but substantial machine for use in shops needing only a small number of lights. It is well constructed, of good material, and is giving excellent results as an 8-light or one-half horsepower motor. At a speed of 2,700 revolutions it has an output of 450 watts. It is ordinarily wound for 55 or 110 volts, but may be arranged for electro-plating.

In the design and construction of their larger dynamos and motors this company has spared no pains to make them equal to any on the market. They have departed somewhat from the ordinary methods of construction employed in this country, and their machines embody a number of points of special excellence.

The base and bearings are in one casting, giving large floor support and the greatest attainable solidity of construction. Great pains are taken to perfectly balance the running parts, and this, in connection with the large base and low bearings, insures perfect smoothness of operation.

Another departure from old customs has been recently made by omitting the handle to the rocker-arm, unless it is specially ordered. The reason for this is, that the brushes do not require readjustment for changing load, and are therefore set by a screw at the non-sparking point before leaving the factory. This has its obvious advantages where the machines are to be run by inexperienced persons, who are more apt to get the brushes out of adjustment than to set them as they should be. The rocker-arm is, however, adjustable, and a handle is attached when required.

This company claims the highest efficiency for their machines, and comparatively slow speed for their type. Thus a 3¼-h. p. 220-volt motor which was recently shipped to Texas was found to run at full speed, without load, on 1¼ amperes.

The latest production of this firm is their Type K dynamo for gas engine sparking, which may be wound for a speed of 1,000 and 2,000, and has an output of fifteen to forty-five watts.

KEYSTONE ELECTRIC COMPANY.

The above concern, with main office and works at Erie, Pa., manufacture a class of high grade electrical machinery that has met with the highest approval from the trade.

Frame.—The base or lower part, having combined with it the journals, is strongly constructed of cast iron, but so designed that no unnecessary amount of metal is used, thereby reducing the floor space occupied by the machine and, furthermore, effecting a saving in transportation charges.

The field yoke or ring, cast in two parts, is made of open hearth steel of the highest magnetic permeability, and is consequently very light for the output of the machine.

The journals are cast in the base, and as the one at the pulley end of the machine is much larger than the one at the commutator end, the most substantial means are employed for withstanding the extra strains due to belt tension.

Windings.—The spools on which the field coils are wound, as shown herewith, are placed on the poles before the latter are bolted to the field yoke, thereby making the coils readily accessible by simply removing the cap screws that hold the poles in place.

The armature is of the well-known ironclad type, wound with coils placed in slots and completely embedded below the surface of the core ; by this arrangement the iron of the armature is brought closer to the poles and the reluctance of the magnetic circuit reduced, so that the capacity of the machine for a given weight is increased ; and furthermore, by lessening the air-gap, the efficiency materially improved.

The commutator is large and each bar is of ample cross section, being made of the purest copper.

The brushes are of carbon and the brush holders are very well designed, securing firmness of pressure and good brush contact. These machines may be overloaded with impunity, they run slowly, are sparkless and represent a high standard of efficiency.

CARD ELECTRIC COMPANY.

There is a satisfaction gained in reading the opening words of a circular printed by the Card Electric Company of Mansfield, Ohio. They say, the growing demand for a simple, compact and serviceable generator or motor for factory use and isolated plants has induced them to bring out their generator. In many respects the conclusions reached by them could only be due to a full appreciation of the needs of the above places, and they are right in claiming the highest commercial efficiency for their apparatus.

The dynamo from an electrical standpoint is built on good engineering principles. The field core and frame is cast in one piece ; a perfect radiation is secured for the field coils and a slow speed is obtained. Bearings that are self-oiling and adjust themselves to the proper position of the shaft are employed in this construction. There is no shifting of brushes required, and the brushes used are made of carbon, which touch at the exact point of commutation without heat or sparking.

Being a thoroughly modern machine its parts are interchangeable, and its general perfection of design and operation has secured for it from conservative men an excellent reputation. Each machine is fully tested before leaving the factory. All the generators are wound for 110, 220 and 500 volts without load, and compounded for 125, 250 and 550 volts at full load.

THE ELEKTRON MFG. CO.

The Elektron Mfg. Co.'s latest type of dynamos manufactured in sizes of 18 K.W. and upwards is to be seen in the illustration. The field magnet is a steel casting with the four inwardly projecting poles cast with the ring. The permeability of this metal is very high and it is but a trifle less valuable magnetically than wrought iron. The field coils are machine wound and slip on the pole-pieces. The radiation of the coils is secured by leaving a small air space between the steel core and the wire.

The machine may therefore be placed in a hot engine room and regulated well without the hampering influence of a hot field of increasing resistance to contend against.

The armature is of the tooth ring type with wire wound on the outside. A two-path winding is generally employed, thus admitting the use of two brushes. When the current is heavy and the voltage low, four brushes are used.

In the illustration the machine is seen equipped with four self-adjusting radial carbon brushes. The fields are wound by machinery on forms which are perfectly insulated and taped before being filled with wire. The armature coils are laid in slots likewise insulated separately.

The rocker-arm never requires rotation, the diameter of commutation being fixed ; it is there permanently secured. The pedestals and bearings are very substantial. The bronze bearings are individually oiled by two loose rings dipping into an oil-container below.

The amount of oil present is indicated by a gauge. Each dynamo is provided with a sliding base belt tightener, screw ratchet lever, pulleys and non-combustible field rheostat.

The dynamo terminals are mounted on a handsome polished slate slab attached to the lower half of the field ring. This machine possesses qualifications that place it among the foremost of American types.

ROYAL ELECTRIC CO.

The Royal Electric Co., of Peoria, Ill., manufactures a line of high grade alternators and their acessories that do not fail in comparison with the best on the market. In this alternator, which is of the "inductor type," there are no moving wires of any description.

Both armature and field wires are entirely at rest, thus removing from the dynamo the great chance of injury that exists in others not possessing this desirable feature: There are no brushes to wear out, no wires that in movving can be abraded, but large areas of radiation and a capacity for overload that is the greatest recommendation in itself.

This machine has self-oiling bearings that are self-aligning, is readily connected up for 1,000 or 2,000 volts and has but few losses of an electric or magnetic nature.

Having stood tests of eight years' continual service, the central station people are heartily in favor of it and endorse it on every occasion.

The alternators of the present day, many of well-known make, are after a lengthy run apt to be found faulty. While this may be due to electrical deficiencies it is more often caused by mechanical defects and weaknesses in construction. The Royal Electric Company have taken special pains to place upon the market a substantial, reliable and thoroughly serviceable alternator.

COMMERCIAL ELECTRIC CO.

The Commercial Electric Co. of Indianapolis, Ind., have entered into the field of electrical manufacturing with the intention of producing the best and most trustworthy class of apparatus that labor and brains can originate. The following description will show in what respects they have succeeded.

Fields.—The field frame is of cast steel of the highest permeability wound with coils that are well protected by taping and able to radiate heat freely, thus keeping this part of the machine at a low working temperature.

Armature.—The Gramme armature adopted by this company is wound so that crossings and overlappings are avoided. The coils with great differences of pressure are further apart and those intervening well insulated from each other. Ready repair is also practicable by having each coil independent.

Being constructed with excellent ventilating surfaces the heat escapes freely. In an armature this is a most important point, as it determines the future of the machine.

The commutator is large and well adapted to the needs of heavy service.

The brushes are carbon, and may be lifted away while the machine is running. Their large cross section and excellent contact prevents any possibility of heat at the commutator.

The bearings are self-oiling and are lined with phosphor bronze sleeves, easily renewed. A solid steel shaft that rotates without vibration or bend is a noticeable mechanical feature. The absence of sparking at full load accentuates the fact that the design of these dynamos is harmonious; this in certain respects being the final test. A smooth running machine, without heat in either armature or field, and sparkless commutation constitutes with a high efficiency the greatest possible desideratum. The popularity of the Commercial Electric Co.'s apparatus is an indication that their future and reputation is assured.

THE ROOT BOILER has been before the steam-using public for thirty years and has during that time become the most popular boiler of its type manufactured. There is much to interest the progressive steam user in the advertisement of the manufacturers, the Abendroth & Root Mfg. Co., which appears in this issue, and our advice to our readers is, look it up!

MR. F. S. DeRONDE, general manager of the Standard Paint Co., is in many respects the most popular young man in the trade. He is at the head of one of the largest industries. His portrait may be found among the group presented in this issue. The Standard Paint Co. are going to present handsome souvenirs to the ladies present at the Niagara Convention and fine leather bill-holders to the gentlemen. The Electrical Age have already received a set.

The following out of-town visitors are registered at the headquarters of the National Electric Light Association for the week ending May 23, 1897:

J. W. Wilson, Sheffield, England.
E. L. Babcock, Cuyahoga Falls, O.
E. B. Douglass, Allentown, Pa.
W. H. Stewart, London, England.
W. F. Bossert, Utica, N. Y.
H. T. Digar, Atlanta, Ga.

Mr. Stillwell's lecture will be delivered in the Park Pavilion on the evening of Wednesday, June 9, instead of at the Lyceum Theatre, as heretofore announced. The pavilion is located in the park of the New York State reservation, and is near both the International Hotel and Cataract House.

From the amount of correspondence being received at this office from central station managers, a most unusual interest is being taken all over the country in the meeting of the association. Several new members were added to both active and associate list during the past week, and numerous inquiries are being answered daily regarding qualifications for membership and usefulness of the association.

The Electrical Age.

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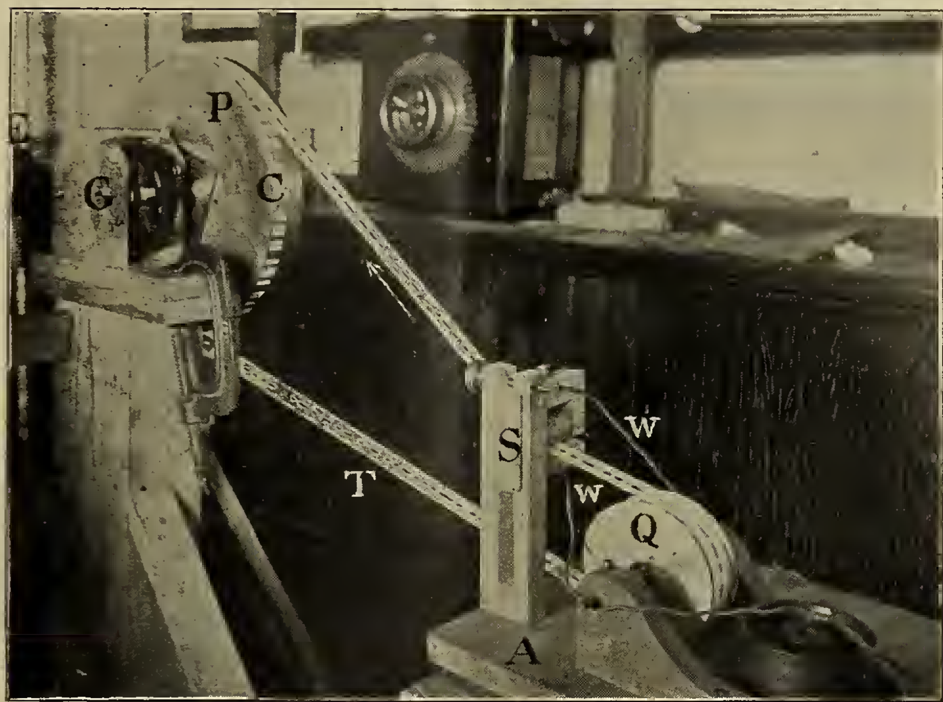

Fig. 6.

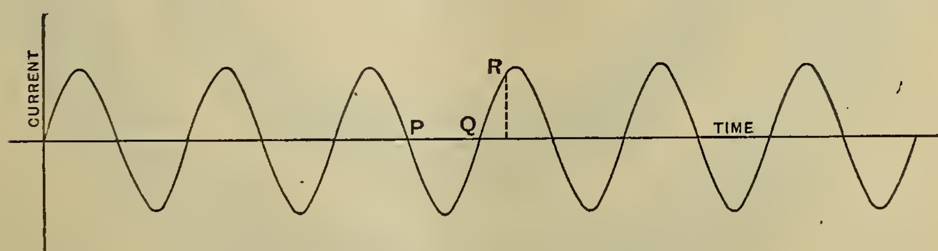

Fig. 1.

THE SYNCHRONOGRAPH.*

A New Method of Rapidly Transmitting Intelligence by the Alternating Current.

BY ALBERT CUSHING CREHORE AND GEORGE OWEN SQUIER.

(Continued from page 349.)

Description of the Transmitter used.

In these experiments, the operation upon the alternating current according to the principles already stated, was accomplished by means of a prepared perforated paper tape, which was caused to move by the generator itself. A view of this tape, showing a method of operating upon the current is given in Fig 6.

The line current is brought through the wires W W to two brushes B B′ not shown in the view, held by the adjustable support S. The plan of the brushes is shown in Fig. 7. One brush B bears upon the tape from above, and the other brush B′ bears from below immediately opposite the other brush so that they will meet through the perforations in the transmitting tape T. When the brushes meet through the perforations in the tape, the line circuit is closed, and when paper passes between them, separating the brushes, the line circuit is broken.

It is so arranged that the brushes pass off from, and on to the paper, thus making and breaking the circuit, at the instant corresponding to the points in the current wave, Fig. 1, when the alternating current is naturally zero. The tape T passes over a wheel P geared to the generator shaft, so that for one revolution of the armature the tape advances a fixed distance. If the generator has ten poles, this fixed distance on the tape corresponds to five complete waves or ten alternations or semi-cycles of the generator current. One-tenth of this fixed distance corresponds to one alternation or semi-cycle of the current, and may be taken as the unit of distance in perforating the tape. If therefore a hole is made in the tape equal in length to this unit, and the brushes B and B′ happen to pass off from the paper so as to meet through the hole at the instant the current is naturally zero, then they will pass on to the paper again, breaking the circuit at the next following instant when the current is also naturally zero since the length of the hole corresponds to one semi-cycle of the current.

Suppose that a succession of these unit holes is made, the tape between the holes being also of unit length, then the circuit will be made and broken as by the first hole at the points of zero current. In practice it would probably not happen that the brushes were at first so situated as to pass of from and on to the paper at the instant the current is zero. In this case a succession of sparks appears, one each time the brushes pass on to the tape, and by moving the brushes along the tape it will be observed that this spark either increases or decreases in intensity, according to the direction moved; but at regular intervals, equal to the unit mentioned above, it disappears. This position of the brushes for no sparking is easily found by trial, and once obtained remains fixed. By this simple practical operation which experience shows requires but a moment to accomplish, the essential condition of synchronously operating upon the current in the manner described is secured. The brushes once adjusted always so remain, and since there is no sparking, it is possible to use high electromotive forces upon the line without injurious effect upon the brushes and tape. It is also plain that this method of operating upon the current is not affected by the speed of the generator, since the transmitting device is always in synchronism with the genera-

tor, whatever the speed. The speed of the generator, and consequently the rate of sending, as far as the transmitter is concerned, can be varied at pleasure between wide limits, without any effect upon the synchronous operation described.

An example, giving the data from an early experiment, will illustrate how this is accomplished. The generator was a Fort Wayne 10-pole alternator giving a potential at its terminals of 1,000 volts. This was transformed to about 300 volts, being convenient to handle, and sufficiently high for the purpose. The end of the shaft E, Fig. 6, of the generator carries a small pinion which engages the gearing G, and revolves the wheel P once in every 18.4 revolutions of the armature. This makes the $\frac{1}{184}$ part of the circumference of the wheel P correspond to one semi-cycle of the current. The circumference of the wheel was about 100 cms., and the length of a unit, therefore, $\frac{1}{184}$ of this, or .54 cms.

For convenience, a tape made of ordinary paper had its two ends joined so as to make a continuous belt, which made it possible to use it repeatedly. The tape passed from the large wheel P to the loose pulley Q mounted upon a base-board, A, and under the guiding pulley attached to the support S which controlled the tape, immediately before passing the brushes B B.'

In preparing the tape, the Continental code was employed as described, the omission of two half-waves meaning a dash, and one-half-wave a dot. Having obtained the length of a unit on the wheel, the tape is first divided into these equal units, and then the proper units are cut out to form a message. The units which are not cut out form the dots and dashes. To use a continuous tape it is necessary for its length to be some exact multiple of the unit in order that it may start on the second revolution exactly as it did the first.

The generator current of high potential passed directly through the primary of a transformer, and the secondary was used as the source of electromotive force for the line. This secondary circuit which includes the line was brought to the transmitter to be operated upon as described.

A diagram of the electric circuits as employed in this experiment is shown in Fig. 8, where A represents the alternator, T the transformer, B the brush bearing upon the transmitting wheel W, and L the line. Another diagram illustrating how the method may be used with currents of the same or different frequencies, is given in Fig. 9, where several generators, A_1 A_2, A_3, etc., are represented upon the same shaft, and each is connected to a separate brush, B_1, B_2, B_3, etc., bearing upon the wheels W_1, W_2, W_3, etc., upon a common shaft and connected to the line. By placing the insulating papers in the proper positions upon the wheels it becomes possible to transmit in succession, first a current of one frequency and then of another, or of all at the same time.

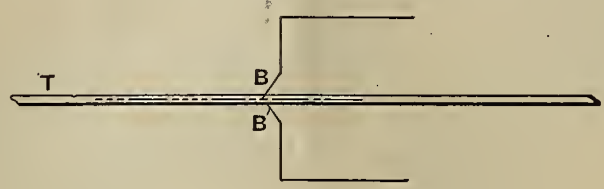

Fig. 7.

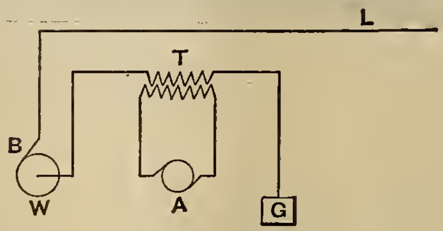

Fig. 8.

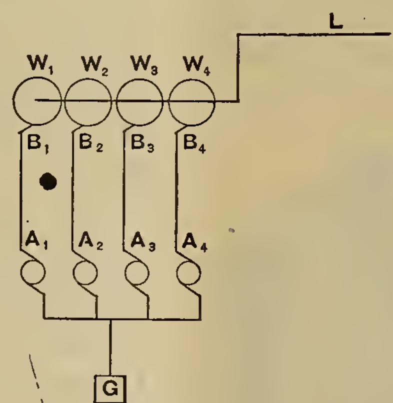

Fig. 9.

If any error is made in laying off the units upon the tape, or if the length of the tape changes in any way after they are accurately laid off, the effect of this error is cumulative from period to period, and, although at any particular time the tape might be in phase, sometimes later it would not be so, and sparking would occur. This would also be the case if there were any slipping of the tape around the wheel P. To overcome these difficulties it is only necessary to have holes punched at regular intervals in the tape which engage in pins at corresponding intervals on a wheel made to receive it.

A simple experimental method which does away with the necessity of making pins to feed the tape, is to glue strips of thin paper, seen at C, Fig. 6, having lengths corresponding to the paper intervals of the tape, that is, one unit for a dot and two units for a dash, upon the circumference of the wheel P, which has a smooth polished metal surface.

One brush is continually in contact with the wheel, and the other rides on to and off from these paper strips, making and breaking the circuit at the zero phase of the current. The length of message permitted is limited by the number of units in the circumference of the wheel, which in the example taken was 184.

Instead of using any gearing, as in the example given, to reduce the speed of revolution of the wheel P, the tape might be run directly from a small wheel upon the armature shaft. The unit on this small wheel is one-tenth of its circumference, if there are ten poles to the generator,

so that any message sent by fastening papers upon this wheel would be limited to ten semi-cycles. If a single unit of this small wheel is covered by paper, and the brush adjusted for no sparking, one semi-cycle in every ten will be omitted. A record obtained in this case with the polarizing receiver is shown in the circle at A, Fig. 10, in which each light spot corresponds to one semi-cycle of current, and it is seen that one in every ten is omitted.

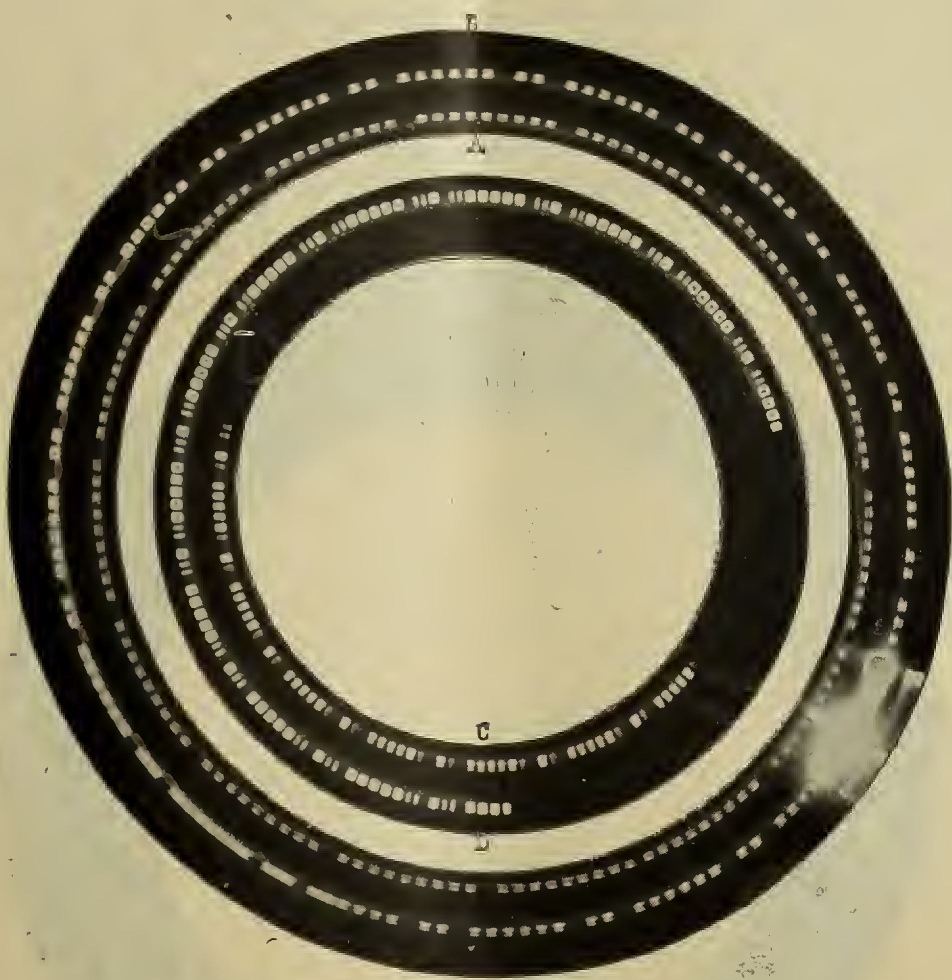

Fig. 10.

The record in the circle B of the same figure was obtained by using two units of paper on the same wheel, having two units between them, and shows that two semi-cycles are omitted in every ten.

Records obtained by the use of paper fastened upon the large wheel P, Fig. 6, are shown in Fig. 11, where it is seen that the word "telegraph" was transmitted. A record obtained by the use of tape is shown in Fig. 12, where the sentence "one wire will do work of ten" was transmitted on August 10, 1896. This message was sent at the rate of 337 semi-cycles of current per second, thus requiring about half a second altogether.

To be Continued.

LECTURE ON THE DIRECT CONVERSION OF ELECTRICITY FROM HEAT.

(Continued from page 360.)

Following that time I was called to Europe, and while there I continued to study the subject of thermo-electricity, and looked into the practical facts and details of what had been accomplished, and then came to something like a sensible conclusion in regard to it. In the first place I concluded that thermo-electric action was due to the junction of two dissimilar metals, or action in a single metal in which there was a rupture of some kind. For instance, if we take an iron wire and tie it into a knot or bend it, and apply heat at the knotted or bent point, we get the thermo-electric effect. I then concluded that the thermo-electric effect was entirely different from the problem which I had undertaken, that is, the direct conversion of heat into electrical energy. I did not believe in the singleness of the problem; that is, if I succeeded in producing a thermo-electric couple which had a high efficiency in the way of voltage and high efficiency in the way of amperage, that that was not the whole problem. I believed that there was another and very important problem, and that was the amount of heat required, and how much would the completed device cost? Cost to make; cost of fuel and cost of attendance—and finally, the length of life it would have in ordinary work. How long will it last, and how much will it cost to purchase and operate, or the question of cost from the practical standpoint, the same as we consider cost in our everyday, work-a-day practical devices; that is, after all, the true objective point of most inventions.

As to the efficiency of thermo-electric couples, it is usually stated in the text-books that the electromotive force of antimony and bismuth is so much, of antimony and platinum so much, and iron and copper so much, but you will seldom or ever see a statement made as to the amperage output of the couple. The ampere is the real, practical side of the thing, aside from the electromotive force. In my investigations I have paid very little attention to thermo-electric couples from the standpoint of their electromotive force. My chief attention has been paid to this—that thermo-electric couples were deficient, not so much in their electromotive force but in their mechanical construction; in the fact of their disintegration; in the fact of their general worthlessness; but I did not believe that there was a possibility of producing thermo-electric elements which would of themselves unquestionably solve the problem. The real question beyond the couple was the question of heat and of the mechanical construction and cheapness of cost of the device. Suppose the question of price should be ignored, and you were simply shown something which produced an electromotive force of, we will say, 25 volts, which is quite within the bounds of possibilities to produce in a device of the size and gas consumption of the one before you. The question you as practical men would ask is, How much does the device cost? how long does it run? and what does it cost to operate?

There is a considerable difference between thermo-electricity and the direct conversion of heat. I could interest you, I suppose, far more by thermo-electric illustrations than I could by any possible illustrations of direct con-

version as shown by these generators. The ones I have to show you tonight, you must remember, are simple, demonstrated commercial facts, and not theoretical possibilities. In taking up the subject of direct conversion of heat, I first looked into the subject from the point of view of the mechanical difficulties that were in the thermo-electric couple. This is what I found, and it was quite alarming to find such difficulties in one problem, conceding it to be a simple problem. I found, first, if you joined two metals together, that there was a great liability to oxidation of the joint. How would oxidation affect the output of the machine? The ampere current which you obtained this minute would be less the next minute, and become less and less gradually, until practically there was no ampere output whatever. Secondly, conceding the fact that we had overcome the oxidation of the joint, was there any other difficulty? Yes, there was, and a very serious one—about as serious as was the difficulty of oxidation; that is, the serious difficulty of the disintegration of the element, its breaking apart or disruption. In this difficulty you have an element which would be all right and apparently strong today, and it would owing to defective structure rupture or break apart without warning. No practical machine could be made with any such couple as that. Another point about the couple was this, conceding that both these difficulties could be corrected, there was still another very serious difficulty in the couple, and that was the fact that they were so fragile that taking a couple of three-quarters of an inch in thickness, you could take it in your fingers and crush it almost to powder ; it was totally impracticable from a commercial point of view, for it was impossible to use any such delicate thing.

I finally started with a view of overcoming these three difficulties ; first, the oxidation of the joint ; second, the disintegration of the element, and third, its extremely fragile nature. I think it will be well if you will concede the fact for a few minutes that I have overcome the defects, so that I may describe how I produce the couples right from the raw metal, clear up to their use in the completed devices which you see before you—just how the work is done, and every detail, as I remember the details now. Then we can see as to how far I have succeeded in producing a practical working thermo-electric device, to what extent I have been able to produce a successful one. I am very sorry that I have not some thermo-electric couples here tonight. I ordered them by cable from England, and they have arrived here and are going through the custom house, but anyone familiar with the customs knows that a long delay in delivery is considered necessary. However, I found in my gripsack today just three couples. Anyone after this talk is over is welcome to look at them and try them and see whether they are fragile or easily broken, particularly as they are only

Fig. 11.

Fig. 12.—Polarizing Receiving Record. Message sent at Fort Monroe, Va., Aug. 10, 1896, at the rate of about 1,200 words per minute. This particular message sent in one-half a second. The number of "dots" per second is 337. Continental Code is used.

one-quarter of an inch in thickness. They are made of two parts antimony and one of zinc, which is Seebeck's old metal, which he used back in 1821. I have always recognized Prof. Seebeck as the father of thermo-electricity.

N. E. L. A. CONVENTION.

NIAGARA has at last been the scene of a unique assemblage, rendered more so on this occasion than any other by the peculiar fitness as it were of the surroundings and its visitors. In everyone's mind at present there is an immediate association of Niagara with mighty wonders. Not alone those of nature but of man himself. The gladiators of a marvellous science have met in the very arena of their greatest efforts to live for a while in the midst of palpitating power, of resistless force and organized energy. The meetings of the N. E. L. A. are to be devoted to questions of lighting and power, and then the various power generating stations will be visited by the delegates.

The big International Hotel has electrical appliances in almost every room and about the corridor. On the big verandas there are rows of arc lights of new styles and designs, which at night illuminate the surroundings with a dazzling brilliancy.

Crowds of Sight-seers.

In the rooms where electrical exhibits were placed, crowds were gathered. Special wires had been run from the Schoellkopf Power House, and there was a supply of electric power for everyone. The Westinghouse Company had six machines in operation, three were two-phase motors, alternating current and others were generators. There were voltmeters, ammeters, switchboards, and different styles of lamps, and best of all the machines were in actual operation.

The General Electric Company had some remarkably fine exhibits of meters and delicately constructed apparatus. Besides all this there were electric fans and small appliances used commonly in stores, hotels, restaurants, etc.

The array of every conceivable style of lamps was elaborate, and many different manufacturers are represented in this display.

Executive Session.—Thursday, June 10, the Executive Committee of the association will meet at 9 o'clock. This committee is composed of A. Markle, of Hazleton, Pa.; W. W. Carries, of Memphis, Tenn.; W. R. Gardener, of Pittsfield, Mass.; G. A. Redman, of Rochester; H. A. Wagner, of St. Louis, Mo.; John Seeley of New York; A. J. De Camp, of Philadelphia; A. M. Young, of Waterbury, Conn.; and Charles R. Huntley, of Buffalo, who is chairman of the committee. The convention assembled at 10.30 o'clock.

Opening Address.

Members of the National Electric Light Association.

Ladies and Gentlemen: In arriving at a decision as to the most suitable place at which to hold the twentieth convention of the National Electric Light Association, the executive committee and your president were guided largely by the desire to select a spot where our members could have some practical illustration of the most recent advances in electrical development as applied to everyday commercial use on an extended scale. Niagara Falls, N. Y., appeared to offer superlative inducements as our place of meeting, judged by this standard, and was accordingly given the precedence; and with a knowledge of the programme that has been prepared for the instruction of onr members and the many interesting features for the entertainment of themselves and their friends, I am confident that before the close of the convention, those present will unanimously be of the opinion that our choice was wisely made.

When we consider that only five years since many of us were in attendance at the fifteenth convention of the association held in Buffalo and were listening to the discussion which followed Dr. Carl Hering's paper on "Transmission of Power," ever the most sanguine of us but little imagined that in half a decade we should be holding our twentieth convention at Niagara Falls, principally with the object of seeing and realising the actual application of motive power derived from the Falls, to some of the most novel and most important industries of the country.

To "harness Niagara" had long been a dream, but is now an actuality, and who can tell the reslutant progress and advancement that we may be destined to celebrate within the next few years.

There is no parallel in history for such rapid development of any industry as that of the manufacture of electrical apparatus and its application, or to be strictly correct and quote ex-president of the association, Mr. M. J. Francisco, who is an authority on the subject, the only parallel was when the world was created in six days out of nothing. Five years ago we were discussing the possibilities of transmitting power in small units to moderate distances. Today the problem is solved and innumerable installations are transmitting power in large quantities for long distances, and yet we have only crossed the threshold.

In this connection I am of the opinion that the lecture to be given tomorrow evening by Mr. L. B. Stillwell will serve as a tidal mark. At the Buffalo convention we occupied ourselves in discussing the possibility or otherwise of transmitting Niagara power to Buffalo. Mr. Stillwell's paper will set forth the various applications of Niagara power at the present time, including transmission to Buffalo; and future presidents of this association will in all probability refer to his paper and draw comparisons when adverting to the strides which will by then have been made in the wider utilization of this mighty power, which for countless ages has been simply running to waste so far as any economic use is concerned and apart from its value as the greatest scenic wonder of the world.

I fully appreciate the honor of presiding at this meeting which for the reasons I have just referred to will be embodied in the annals of the association as marking an historic epoch in the advancement of the science of electricity as applied to industry, and it is therefore with more than ordinary satisfaction that I am authorized to state that at no previous meeting has this association been so prosperous, shown greater vitality or commanded such respect. It is now an acknowledged authority on matters electrical; its membership confers a privilege that has more than a sentimental value, and its gathering strength will offer a bar to use of powers municipal or corporate unjustly or arbitrarily directed for the purpose of destroying the capital investment of those who look to it for protection.

In union is strength, and today our membership numbers more active members than ever before, and the financial statement to be presented in due course by the chairman of the finance committee will show that, after making provision for all expenditures necessary to maintain the usefulness of the association, an unusually large credit it balance is at your disposal.

It is certainly cause for congratulation that increasing prosperity has been followed by an access of dignity and influence and the more recent meetings have been re-

markabie for the greater interest that has been taken in the actual work of the association and the lesser attention that has been given to the merely social and entertaining features of the programme.

The desire to make the twentieth convention notably a business meeting has so far predominated that we have neither asked nor accepted any favors other than from the electric power companies and several of the manufacturing establishments using electric power for the operation of their works.

Although several delightful and interesting excursions have been arranged for, the association has made, on behalf of its members, a business-like arrangement for the several trips and excursions set forth in the programme of the convention, preferring to pay our way rather than tax the courtesy of the transportation and other companies by accepting dead-head privileges. In view of the fact that I have had occasion to communicate with our members from time to time during the past year by the issuance of the of printed "Interim Reports" referring to the work undertaken by your executive, it is unnecessary to give an account of my stewartship in this address, but I may say that many matters of urgent importance are pressing for settlement and which will doubtless receive the most careful attention at your hands during the next few days.

As we have a lengthy programme before us and several important reports of committees to receive and discuss before we adjourn for mid-day recess, I now declare the Twentieth Convention of the National Light Association opened and ready for the transaction of business.

The report of the committee on safe wiring was heard; the details of the report may be found in later issues of this paper being too lengthy for immediate publication. Likewise the details of the sessions of the N. E. L. A. convention meeting. At the opening session letters of invitation from the following concerns were produced:

Niagara Falls Power Co.

Niagara Falls Power and Hydraulic Co.

Buffalo and Niagara Falls Electric Light and Power Co.

American Telephone and Telegraph Co., and a letter from B. A. Green, Grand Central Palace, New York.

Letters of regret from the following: Prof. Edw. L. Nicholls of Cornell University; Sir Wm. Dawson, Magill University, Montreal, and Lord Kelvin of Glasgow University, Glasgow.

PAPERS READ AT THE CONVENTION.

The Establishment of a Base Price for Current. J. B. Cahoon, Elmira, N. Y.

Samuel Insull, President-Elect N. E. L. A.

The list of papers to be read at this convention is an exceptionally good one, and the authors are of more than continental reputation, and I, the referee, trust that our members will show the appreciation of the care and study given to these papers by being present in force at every session and taking an active part in the discussions that will ensue.

Notwithstanding the progress that has been made in the perfection of apparatus and the application of new principles, there never was a time when there was more to learn than now, and no more fitting occasion is likely to present itself to us to familiarize ourselves with the latest procedure in our chosen profession, and the papers to be read and the discussions thereon will find hundreds of readers and students, thanks to the electrical journals, of which we are all justly proud.

No other art, science, industry or profession has been so well and faithfully served by an enlightened and progressive technical press as our own, and who can estimate the fair share of credit justly their due for the part they have taken in aiding and advancing the introduction of electromotive force in its many and varied applications.

The Daylight Work of Central Stations. T. C. Martin, New York.

Recent Progress in Arc Lighting. Elihu Thomson, Lynn, Mass.

The Induction Factor, a New Basis of Dynamo Calculation and Classification. Prof. Chas. A. Carns-Wilson, Montreal, Canada.

Municipal Lighting. W. Worth Bean, St. Joseph, Mo.

Report of Committee on Data. H. M. Swetland, chairman.

Report of Committee on Standard Candle Power of Incandescent Lamps.

Rotaries for Transforming Alternating into Direct Current.

The Polyphase Motor.

ARRIVALS ON SPECIAL TRAINS.

The members and guests on the special train that left New York City at 10 A. M. June 7th arrived at Niagara Falls at 11:45 P. M. They were received by a large contingent of early arrivals, with a band of music. President Nicholls, assisted by Messrs. Peck, Carroll, Ayres, Harrington, Johnston, Hunt and many others, gave the

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NEW YORK, JUNE 12, 1897.

CONTENTS.

ANOTHER TROLLEY VICTORY.

The advent of the trolley is no new thing to either the city or suburban resident. The cobweb of lines radiating out from power stations in many large cities is something surprising; in fact, in many cases, awe inspiring. But when the line begins to stretch beyond, to pass the suburban districts, and to reach out like the arm of an octopus to a point that is a considerable distance away, a new interest in the trolley springs up. The advantage to any large and busy centre of being connected by this means with a somewhat remote but growing town is immense. It is generally the case that these widely separated points become included eventually within the city's limits very rapidly when connected with the city proper by some easily available means of transit. The Cincinnati & Miami Valley Traction Company have completed a new line that is operating very well according to report. The announcement was worded in one of the daily papers of that place as follows:

Miamisburg, Ohio, May 26.—The first car on the Cincinnati and Miami Valley Traction Company's new electric line was run through to Franklin to-night. Its arrival at Franklin was greeted by the citizens en masse amid a wild chorus of cheering. General Manager W. G. Wagenhals was at the motor, while Stern, of Philadelphia, and G. L. Shermerhorn, general engineer, and Judge Dwyer, of Dayton, were interested passengers. Enthusiastic speeches were made by Judge Dwyer, of Dayton, and ex-Mayor Harding, of Franklin. Traffic will now begin regularly between Franklin and Dayton.

The road to success in this case seems to be indicated pretty clearly. A trolley road running through the Sahara Desert, we think, would eventually be lined with a series of little connecting towns; as this seems to be the ultimate result of its installation in almost any locality.

NIAGARA CONVENTION.

The delegates that arrived at Niagara for the purpose of attending the convention of the National Electric Light Association enjoyed themselves as well as their expectations had led them to believe they would.

Special train loads arrived until the rendezvous, the International Hotel, was filled with the representatives of a myriad of interests. It may be generally known already, but is worth while stating again, that of all classes of professions able to enjoy themselves together none can surpass, if equal, a conclave of electricians. Some mutual sympathy draws them together, and not a moment is wasted in becoming well acquainted in spite of the greatest opposition. It may be due to the strong personal magnetism of the N. E. L. A. members or the inductive effect of this central cause upon the assembled visitors and guests; be it what it may, it provides a healthful social atmosphere in which move with buoyant animation president, officers, committeemen and members.

They meet with the intention of doing work as well as enjoying themselves and can proudly say that on every occasion of their unification have achieved something of value to the general interests they represent.

Thus far the literature produced by the N. E. L. A. is truly the most refreshing reading of its kind. It enters into particular fields of electric lighting that require considerable experience on the part of their exponents to give them power to produce a clear and logical essay, which, without entering too closely into details, gives the subject the proper treatment and the reader thorough satisfaction.

Many of the members were deeply interested in the visits to various power concerns distributed around in the neighborhood of Niagara. It is there, we might say, that one might view the verified predictions of the last decade in the use of the power of N agara and its application to a great variety of commercial interests. The future of Buffalo, to a large extent, depends upon the development of the power resources of Niagara, and the only matter of doubt remaining is that which relates to the use of it. Restrictions may be imposed by the American and Canadian authorities limiting the power used to a certain maximum figure which will thus prevent the waters from being appreciably affected, or in any way destroying the magnificent wildness that characterizes Niagara and its vicinity.

The election of Mr. Samuel Insull as president of the N. E. L. A. is considered by all an excellent choice. Mr. Insull has the interests of the association at heart; has worked in many quiet ways for its advancement, and has striven to his utmost on all occasions to support its dignity and uphold its worth. It is quite an honor to be the chief representative of an organization that includes among its members the most able electrical engineers of this country, and many of the greatest names of England and other foreign countries.

Edward King, colored, of St. Louis, has been sent to a hospital in that city for observation as to his sanity. King is an enthusiast on electricity, and says his heart generates any amount of it while he is at prayer. It goes from his heart to the ground and returns by way of his feet and limbs, forming a complete circuit, but interfering more or less with his devotions. He was about to enter upon a series of experiments, with a hope of diverting the current from his body for commercial purposes, when his employer thought he needed medical surveillance and had him taken to the hospital.—*Electricity.*

new guests a good reception and all reached headquarters in order, signed the register and retired, to be ready for an early start on Tuesday.

Members and Guests Present :

Swetland, H. M., Power, N. Y.
Richards, Wm. F., Newport E. L. Co., Newport, N. H.
Tenney, M. W., " " " " "
Paine, F. B. H., West. Elec. & Mfg. Co., Boston.
Bottomly, H. B., Marlborough Elec. Co., Mass.
Holmes, W. E., N. & W. G. Light Co., Newton, Mass.
May, H. A., Elec. Eng. & Supply Co., Syracuse.
Bilyeu, S., N. E. L. & P. Co., Phila.
Sigg, J., " " " "
Parsons, W., Marble City Elec. Co., Rutland, Vt.
Winchester, S. B., Holyoke W. & P. Co., Holyoke, Mass.
Laylor, O. P., L. H. & P. Co., New Phila., O.
Garland, J. C. C., Buffalo General Electric Company.
Hanley, G. W., Marionette, Wis.
Stevens, E. H., Subway Electric Co., Elizabeth, N. J.
Sandt, G. F., Georgia Electric Light Co., Atlanta, Ga.
Dee, J. R., Peninsula E. L. & P. Co., Houghton, Mich.
Bean, W. W., St. Jo, Mo.
Allen, H. L., Wyckoff Conduit, Williamsport, Pa.
Gillets, E. K., General Electric Co., Cincinnati, O.
Martin, Messrs. T. C. and R. G., E. E., New York.
Vail, J. H., Brush Electric Light Co., Philadelphia.
Meyer, H. G., Dolgeville E. L. & P. Co., Dolgeville, N. Y.
Brophy, Wm., Wire Department, Boston, Mass.
Conklin, L. H., Flatbush G. Co., Brooklyn, N. Y.
Jones, A. T., New Brunswick, N. J.
Price, C., B. P. A. Co., Boston, Mass.
Hall, A. F., G. & E. Co., Southbridge, Mass.
Kick, T., P. B. Electric Co., Savannah, Ga.
Schutt, D. A., Peru E. & Mfg. Co., Peru, Ind.
Covington, F. D., " " " "
Holman, G. G., Chlt. E. L. H. & P. Co., Philadelphia.
Lynch, A. H., Morris Co. Elec. Co., Morristown, N. J.
Sewell, J. E., Waterbury T. Co., Waterbury, Conn.
Gates, H., Walker Co., Chicago.
McCabe, E. F., General Electric Co., Chatham.
Coster, M., Western E. & M. Co., Chicago.
Harding, W. H., Baltimore G. E. Co., Baltimore, Md.
Davis, D., Salem E. L. P. Co., Salem, O.
Osborne, W. F., Western Electric, New York.
Jenning, J. J., Wilks Electric Co., Wilks, Pa.
Wilkinson, C., D. W. Electric Co., Chicago.
Grier, G. G., D. W. Electric Co., Chicago.
Johnson, E. O., Boston Electric Co.
Hybroo, H. C., Los Angeles, Cal.
Whitehead, J. B , Niagara Falls Power Co.
Dunlop, W. K., Westinghouse Elec. and Mfg. Co., Pittsburgh.
Barrett, W. J., Roebling's Sons, Los Angeles, Cal.
Schoellkopf, A., S. N. F. Ry. P. Mfg. Co.
Carroll, John, E. F. Phillips Electric Wks., Montreal.
Rothney, J. A., N. F. Park R'way, Niagara Falls.
Latt, F. G., Buffalo and N. F. E. L. & P. Co.
Candee, Willard L., Okonite Co., N. Y.
Manson, Geo. T., Okonite Co., N. Y.
Peck, E. H., Phœnix Glass Co., N. Y.
Chase, Samuel A., Western Electric Co., N. Y.
Crane, N. F. D., H. W. Johns Co., N. Y.
Williams, J. P., Paragon Motors, N. Y.
Benedict, W. P., Standard Paint Co., N. Y.
Biggar, E. B., E. E., Niagara Falls.
Hoover, P. H., N. Y. Ins. Wire Co., N. Y.
Packard, W. D., N. Y. & O. Co., Warren, O.
Packard, Miss C., Warren, O.
Tremaine, H. A. Crouse, Tremaine Carbon Co., Fostoria, Ohio.
McDonald, W. B., Peoples E. L. & P. Co., Chicago.
Radford, J. A., Peoples E. L. & P. Co., Chicago.
Doan, J. P., Jacksonville G. Lt. and Coke Co., Jacksonville, Fla.
Isaacs, M. J., Chicago.
Isaacs, Mrs. M. J., Chicago.
Astruck, J. H., Pioneer Arc Lamp, N. Y.
Brooks, H. H., Amer. Cir. Loom Co., Boston.
Insull, Samuel, Edison Co., Chicago.
Ferguson, L. A., Edison Co., Chicago.
Lieb, J. W., Jr., Edison Ill'g Co., N. Y.
Habirshaw, Dr. W. M., Habirshaw Wire, N. Y.
Morris, E. P., New York.
Murphy, J., Ottawa Electric Co., Ottawa, Can.
Wilson, William, Milwaukee, Wis.
Nicholls, F., Toronto E. Light Co.
Coles, S. L., Elec. Review, N. Y.
Daniels, A. L., H. R. Lamp Co., Aultman, O.
Fessenden, R. T., Hope Electric Appliance Co., Providence, R. I.
Bradley, J. M., Consol. Elec. Co., Birmingham, Ala.
Ayer, J. I., Amer. E. H'tg Corp., Boston.
Roehl, C. E., St. Jo L. H. & P. Co., St. Jo, Mo.
Peabody, D. W., Fenton E. L. Co., Fenton, Mich.
Hills, C. I., Perkins E. Co., New York.
Kimball, F. M., General Elec. Co., Boston.
Copeland, F. A., Edison Co., La Crosse, Wis.
Barstow, W. C., Ed. El. Ill. Co., Brooklyn.
McQuaide, J. P., Nat. Conduit & Cable Co., N. Y.
Cummings, J. F., Armorite Int. Conduit Co., Pittsburgh, Penn.
Arnold, W. L., General E. Co., Chicago.
Fairbanks, H. H., Worcester Elec. Light Co., Worcester, Mass.
Paine, S. B., Gen. Elec. Co., Boston.
Bush, A. R., Gen. Elec. Co., Boston.
Haskins, C. D., Gen. Electric Co., Boston.
Ryan, W. D. A., Gen. Elec. Co., Lynn, Mass.
Hastings, A. C., Mayor, Niagara Falls.
Johns, S. C. D. and wife, Cleveland E. I. Co., Cleveland, Ohio.
Phillips, W., N. F. Park & R. Ry., N. F.
Livingston, M. L., Std. Chem. Co., Peabody, Mass.
Solomon, J. I., Bryan Marsh Co., N. Y.
Smith, T. C., Keystone L. & P. Co., Phila.
Drake, J. I., Hope Elec. Appl. Co., Providence, R. I.
Hughes, T. E., Std. Und. Cable Co., N. Y.
Wiley, G. L., Manager " " " N. Y.
Perry, N. W., Electricity, N. Y.
Shain, C. D., New York.
McGhie, J., Gen. Elec. Co., N. Y.
Sachs, J., Elec. World, N. Y.
Adams, T. E., A. B. Elec. Co., Cleveland.
Cox, G. E., Acetylene H. & P. Co., Niagara Falls.
Mason, J. H., Simplex Elec. Co., Boston.
Lewis, R. E., Paranite Wire Co., Jonesboro, Ind.
Marks, L. B., Electric Arc L. Co., Pittsburg, Pa.
Chamberlain, W. W., Electric Co. of Va., Norfolk, Va.
Benine, J. McN., Wash. Carbon Co., Pittsburg, Pa.
Hurlburt, T., Norwich, Conn.
Smith, W. S., Toledo Consolidated Electric Co., Toledo.
Howard, F. S., Standard Paint Co., Chicago.
McLeod, T. I., McLeod, Ward & Co., New York.
Kieley, T., Kieley & Mulle, New York.
Voorhees, F. M., Subway Traction Co., Elizabeth, N. J.
Stevens, J. F., Keystone Elec. Inst. Co., Philadelphia.
Heinrichs, E. H., Westinghouse Elec. Co., Pittsburg, Pa.
Merceine, T. R., Northwest Elec. Ass'n, Milwaukee, Wis.
Engel, W. P., Charlotte Elec. Co., Charlotte, Mich.
Tarbert H., Dubuque L. & T. Co., Dubuque, Iowa.
Young, A. M., Central Elec. & Rwy. Co., Waterbury, Conn.
Harper, T. J., Supt. City Elec., Atlanta, Ga.
Smith, F. E., Somerville, E. L. Co., Somerville, Mass.
Sparrow, E. S., " " " "
Cutter, Mr. & Mrs. H. B. C., Elec. & Mfg. Co., Phila., Pa.
Hammer, W. J., E. E., New York.
Clay, Mr. & Mrs. H., N. E. L. & P. Co., Philadelphia.
Moore, W. E., Augusta Railway & Elec. Co., Augusta, Ga.
Prentiss, I. R., G. E. Co., Cleveland.
Wyant, R. E., Derby Elec. Co., Derby, Conn.

Stierenger, L., E. E., NewYork.
Reid, J., " "
Stetson, G. R., N. B. G. & Edison Light Co., New Bedford, Mass.
Price, P. P., " " " " "
Davis, Mr. & Mrs. C. B., Boston.
Lawrence, W. H., Cleveland.
Tullech, S. W., Wash., D. C., U. S. Elec. Light Co.
Greene, L. W., Brooklyn E. L. Co., Brooklyn, Mich.
Crider, J. S., Wash. Carbon Co., Pittsburgh, Pa.
Lean, G. R., Jandus Elec. Co., Cleveland.
Brayton, M. J., Utica Elec. L. Co., Utica, N. Y.
Pyle, J. E., Edison E. I. Co., West Chester, Pa.
Purse, H. A., Pawtucket, Elect Co., Pawtucket, R. I.
Smith, A., " " " "
Henderson, A., New York Fire Department.
Williams, A., Edison Co., Brooklyn, N. Y.
Ackerman, P. C., Amer. Elec. Works. "
Stover, H. B., Stover Elec. Engineering Co., New York.
Durland, D. C., Int. Con. Co., New York.
Beggs, J. I., Central Edison Co., Cincinnati, O.
Godfrey, J. W., Habirshaw Wire, New York.
Eyre, M. K., G. E. Co. "
Baker, C. O. Jr. and wife, New York.
Bradley J., Bernstein Lt. & P. Co., Boston.
Calesch, J. C., G. E. Co., Pittsburgh, Pa.
Morton, C., Temple Elec. Co., Montreal.
Smith, R. D., Westboro, G. & E. Co., Westboro, Mass.
Law, D. W., Wellsville G. & E . Co.. Wellsville, Ohio.
Greene, S. Dana, G. E. Co., Schenectady, N. Y.
Claflin, G. E., Lewis & Claflin, Providence, R. I.
Miller, A. M., Red Oak Electric Co., Red Oak, Iowa.
Harting, J. J., American Electric Co., Detroit, Mich.
Mills, E., Pontiac Ed. E. L. Co., Pontiac, Mich.
Titgell, W. W., Jersey City Elec. Lt. Co., Jersey City.
Armstrong, E. A., Camden L. & H. Co., Camden, N. J.
Armstrong, Master M. V., Camden, N. J.
Flash, E. L., Jandus Electric Co., Philadelphia, Pa.
Grier, E. R., Bryant Electric Co., Chicago, Ills.
Baker, M. H., Puritan Electric Co., Boston, Mass.
McConnell, M. J., Electrical Engineer, Cleveland, Ohio.
Barnes, C. R., City Electric, Rochester, N. Y.
Bernard, E. G., Troy, Electrical Engineer.
Canfield, M. C., C. C. Railway Co., Cleveland, Ohio.
Laughlin, F. M., Solar Carbon Co., Pittsburg, Pa.
Meestard, O. H., Wagner Electric Co., New York.
Rockefellow, E. W., Western Electric Co., New York.
Gaffney, A. J. Jr., Newark E. L. and P. Co., Newark.
Adams, H. C. J., Phillips Wire, Pawtucket, R. I.
Luphe, P., Trenton L. and P. Co., Trenton, N. J.
Carrier, A. E., Faraday Carbon, Jeannette.
Baker, E. F., Brush Electric Co., Baltimore, Md.
Douds, H. J., Brush Electric Co., Cleveland, Ohio.
Rogers, W. S., Brush Electric Co., Cleveland, Ohio.
Lyman, H. M., Canton L. H. and P. Co., Canton, Ohio.
Smith, J. B., Manchester Elec. L.Co., Manchester, N.H.
Watts, G. W., Canadian G. E. Co., Toronto, Canada.
McCormick, E. D., Canadian G. E. Co., Toronto, Canada.
McCollough, W. M. H. Reisinger, New York.
Smith, F. D., Sawyer-Man, Pittsburg, Pennsylvania.
French, S. L., Brooklyn, N. Y.
Upton, F. R., New York.
Harvey, O. W., C. A. Shieren & Co., New York.
Scheefer, G. A., Diamond Electric Co., Peoria, Ills.
Ballda, W. C., Utica Elec. and Mfg. Co.. Utica, N. Y.
Andrews, J. M., G. E. Co., Schenectady, N. Y.
Rice, J., Cleveland Carbon Co., Cleveland, Ohio.
Frenyear, T. C., Westg. Electrical Co., Buffalo, N. Y.
Dixon, T. W. G. E. Co., Columbus, Ohio.
Wilcox, N. T., Seneca Falls, N. Y.

JOHN R. MASSEY, in charge of the Buckeye Electric Co., exhibited in vestibule of hotel. Their lamps were of all colors and shapes, some of beautiful design, a variety of candle-powers were open for examination.

THE KEYSTONE ELECTRICAL INSTRUMENT CO., of Philamuth street and Montgomery avenue were represented at the N. E. L. A. Convention by Mr. J. F. Stevens. The instruments of this company, as well as the gentlemen in charge, cannot be better described than with the words taken from their own catalogue, "Pleasing in appearance, sensitive and accurate, constant and durable."

THE WALKER COMPANY, with main office at Cleveland, Ohio, was represented at the Niagara convention by Mr. M. C. L. Harding. This company stand ready to take orders for alternators and motors. Their inductor alternators are wound for single, two or three-phase transmission.

PARTRICK & CARTER CO., dealers in electric supplies, 125 Second street, Philadelphia, were represented by Thos. L. Townsend. One of this company's signs read: "Our health is good, consequently we are in business for something else."

WESTERN ELECTRIC CO., of Chicago and New York, had a fine exhibit in the rotunda in charge of C. D. Wilkinson and Thos. R. Grill, of Chicago, and Samuel Chase and Ed. Rockefellow, of New York. Excellent line fan motors were exhibited. They sell everything electrical.

SCHEEFER WATTMETER exhibit attracted quite some attention. It is manufactured by the Diamond Electric Co., of Peoria, Ill. Mr. G. Scheefer took care of his own exhibit.

GALES COMMUTATOR COMPOUND for the prevention of sparking occupied the attention of many visitors. K. McLennan & Co. are the sole manufacturers of Chicago; their representative was Mr. M. J. Isaacs.

THE CLOOS HIGH POTENTIAL JUNCTION BOX for alternating and direct currents, patented and manufactured by Jacob Cloos, of Milwaukee, Wis., was in charge of Wm. Wilson, E. E.

THE ELECTRIC ARC LIGHT CO., of 687-689 Broadway, N. Y., pioneers in enclosed arc lighting, had the private office of the International Hotel fitted out with a number of different styles of enclosed arc lamps. Mr. J. H. Astruck installed the lamps. The company gave away silver match boxes as souvenirs. Mr. Louis B. Marks, E. E., the chief-engineer of the Electric Arc Light Co., looked after the exhibit.

J. P. WILLIAMS had an exhibit showing a pyramid of running Paragon fan motors. Their New York address is 39 Cortlandt street.

THE STANDARD PAINT CO., manufacturers of water, acid and alkali proof paints and compounds, had an exhibit of their goods at the International Hotel. They were represented by F. S. Howard, of Chicago, and H. W. Benedict, New York. A full line of standard goods were ready for inspection.

THE JANDUS ELECTRIC CO., of Cleveland, Ohio, were represented by Geo. R. Lean, superintendant and inventor with Jandus. This company will hereafter sell their own lamps. The Jandus arc lamps were formerly known as the Manhattan. Their lamps are made for all currents, and the whole field of arc lighting is now covered by their improvements and new methods.

THE WIEMANN LONG BURNING OPEN ARC LAMPS were used for lighting up the front of the N. E. L. A. headquarters, the International Hotel. Broad carbons of substantial appearance are used in this lamp, which is of solid mechanical construction and long hours of burning. Address Wieman Electric Co., Washington, Pa.

MR. C. C. GARTLAND, of 370 Maryland street, Buffalo, N. Y., manufacturer of arc regulators, was present at the convention.

THE STANDARD THERMOMETER AND ELECTRIC CO., of Peabody, Mass., manufacturers of arc lamps and thermometers, were represented by M. L. Livingston, the assistant manager.

THE D. & W. FUSE CO., 53 Aborn street, Providence, R. I., were well assisted by their representative, Mr. Wm. C. Woodward. A full line of non-arcing fuses were on exhibition. All high tension circuits of Boston are protected by these fuses. The souvenirs of this company were fuse cases enclosing a fragrant Havana. The case was inscribed "The contents of this tube may be of service to you." Were they wrong?"

THE IMPROVED GARTON LIGHTNING ARRESTERS were in charge of Elmer P. Morris, selling agent, rooms 40, 41, 42, No. 15 Cortlandt street, New York. These excellent arresters are in use by street railways, central stations and isolated plants, etc. It is furnished with a wooden cover if desired. They are positive in action and last indefinitely. Also Nowotney Arc Lamps and Monarch Insulating Paint.

MR. T. H. BRADY, manufacturer of arc cut-out boxes, Brady mast arms, pole hoods, sleet proof pulleys and all kinds of brackets, of New Britain, Conn., took individual care of his own interests at the Convention hall.

MR. A. L. DANIELS, representing the H. B. Camp Co., manufacturers of Camp's Underground Conduit, of Aultman, O, enjoying the sights and convention. Had a big show of samples.

BRYAN-MARSH COMPANY, manufacturers of Imperial incandescent lamps, of 136 Liberty street, were ably represented by John P. Solomon, an engaging gentleman of popularity, ability and enterprise.

THE CHAPMAN DIRECT CURRENT VOLTAGE REGULATOR was represented by Mr. Brewster, of the Brewster Engineering Co., selling agents, Greenwich and Thames streets, New York, also the Belknap Motor Co.'s motors, which did credit to their name.

THE PHŒNIX GLASS CO., of Pittsburgh, had covered the hotel with "Glad Hands," index fingers with directions engraved on them and an incandescent lamp within. Room 6 was a centre of attraction. Mr. E. H. Peck, the representative of the Phœnix Glass Co., has made a hit. This is his habit.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., of Pittsburg, Pa., issued a handsome circular making mention of a few of their largest installations at Niagara: The Niagara Falls Power Co., Niagara Falls Hydraulic Power and Manufacturing Co., Buffalo and Niagara Falls Electric Light and Power Co., Niagara Electric Chemical Co., Acetylene Light, Heat and Power Co. and the Mathieson Alkali Works.

MR. SAMUEL INSULL, general manager of the Edison Illuminating Co., Chicago, was elected president of the National Electric Light Association at the June 10th meeting of the executive committee.

C. F. PERRY, of the Brooklyn Edison Illuminating Co., and C. E. STUMP attended the convention on their way from Detroit, where they had been present at the Great Shriners' meeting.

MR. E. WARD WILKINS, general manager of Partrick & Carter, was on hand to enjoy the N. E. L. A. convention.

Representatives of the Fort Wayne Electric Corporation at the Electric Light Association at Niagara Falls were Charles S. Knight, vice-president and general manager; James J. Wood, from Fort Wayne, ind. general superintendent of the factory; Thos. Duncan from Fort Wayne, in charge of meter department; C. H. Philbrook, Buffalo representative; John H. Finney, Rochester representative; Thos. Cooper, Pittsburg representative; F. A. Wunder and J. C. Lott, New York office.

The above are a fine looking lot of men and make a very strong team. They are all liberal fellows and freely dispensed their cigars, which were of exceptional quality.

It was also remarked by several of the central station men that they were excellent entertainers and took pains to show visitors all points of interest in the city, upon which they seemed to be very well posted.

ARMORITE.

Mr. James F. Cumming of Detroit is the chief promoter of the use of Armorite interior conduit or wood-lined tubing. This manufactured article is called Armorite, and its use and production has been developed in detail by Mr. Cummings. The conduit consists of ten-foot lengths of iron tubing lined within with basswood. There is considerable ingenuity exercised in forming the wooden tubing, each half of which is made to fit tightly and securely into the other. The wooden interior is made in two parts—two halves which are tongued and grooved to fit perfectly, so that when they are placed in conjunction within the tube a substantial wooden-lined pipe results. During the last few weeks the labor of moving the entire plant from Detroit to new headquarters in Pittsburgh has been going on. This transposition will be of great value to the company as it will then be at a centre from which transportation is greatly facilitated. The Pittsburgh Tube Works have entered into negotiations with the Armorite Company giving them the rights to a section of its great works on Brady street and Second avenue. The difficulties met with in getting their iron covering quick enough to meet the demand brought the company to a focus of opinion on the subject of moving to a place better suited to their needs.

When armorite lead became a known and indispensable adjunct of electrical work the Armorite Interior Conduit Co. of Detroit was organized. A considerable number of patents were obtained by this concern and the Cummings Conduit Co. The protection afforded by the Patent Office in the interests of Mr. Cummings was made use of on every occasion.

His executive power was effective in forming the Armorite Interior Conduit Co., on April 3, 1896. The following officers were elected:

James F. Cummings, president and general manager.
John Thomas, secretary and treasurer.
William Cummings, superintendent.

The Cummings Conduit Co. have as their chief executive J. F. Cummings; W. C. Yawhey, vice-president, and T. J. Austin, secretary and treasurer.

Mr. James Cummings is a man of strong personality. His persistence and bull dog tenacity have had the effect of making obstacles disappear from his path, and his ability and judgment enabled him to retain the respect and esteem of all his friends.

Mr. Cummings received many hearty congratulations at the N. E. L. A. Convention for the success he has achieved.

Geo. L. Wiley represented the Standard Underground Cables and Wires. Mr. Wiley received word from the West that his company had secured a big order for over 100,000 feet of cables. While at the convention he wore his usual suave manner.

Leonard F. Requa, E. E., general manager and inventor of Safety insulated wires and cables, lent his presence at the convention.

J. I. Ayer, E. E., represented the American Electrical Heating Corporation of Boston. He had a fine line of goods; also exhibited his Automatic Circuit Breaker.

THE INTERNATIONAL ARC LAMP CO.

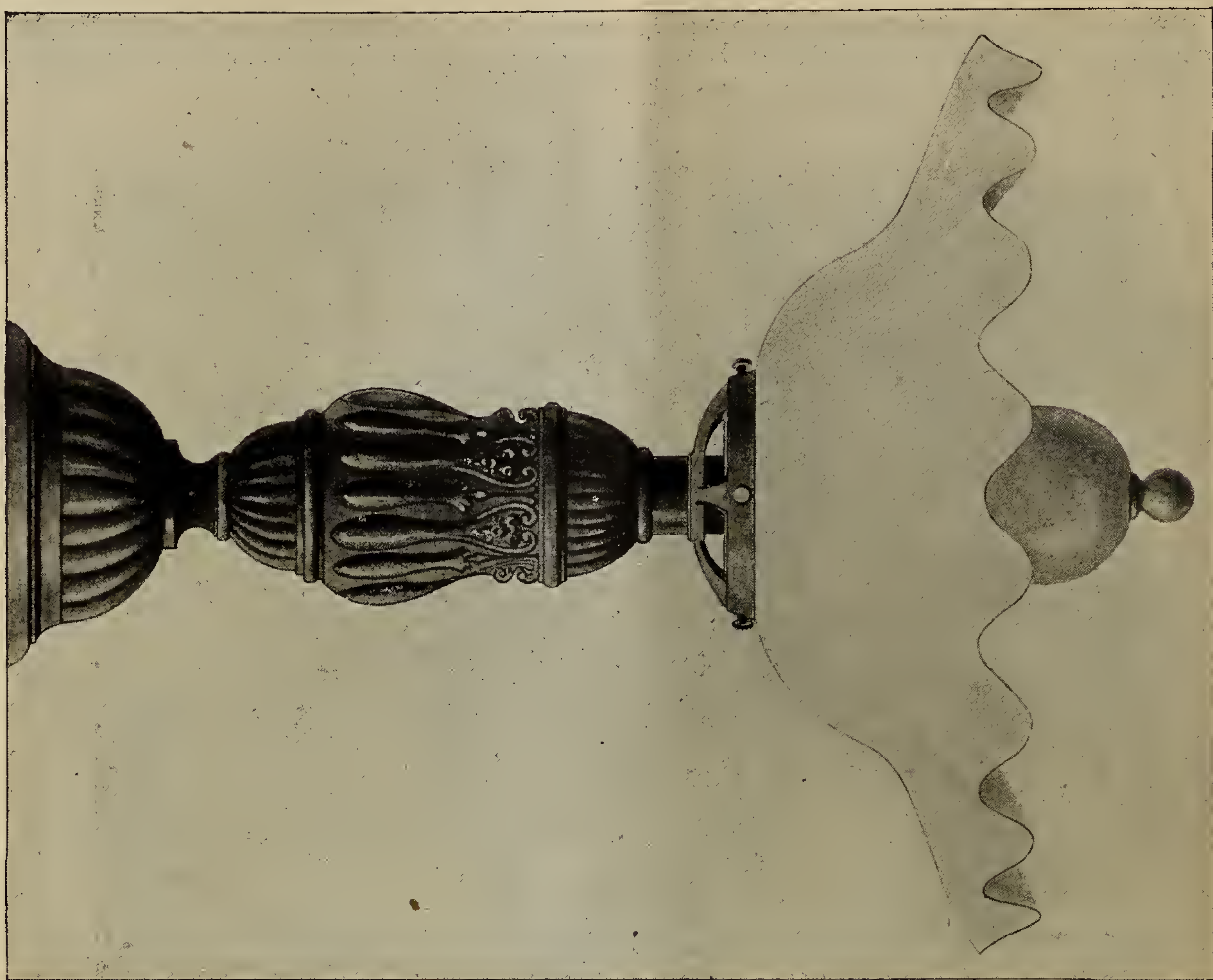
A lamp that has given general satisfaction, and whose excellent design leaves nothing to be desired, is being manufactured and sold by The International Arc Lamp Co., of New York City. Their office and salesrooms, at Mercer and Houston streets, give an opportunity to all interested to call and see the operation of these perfected lamps, to admire their beautiful finish and remarkable illuminative powers.

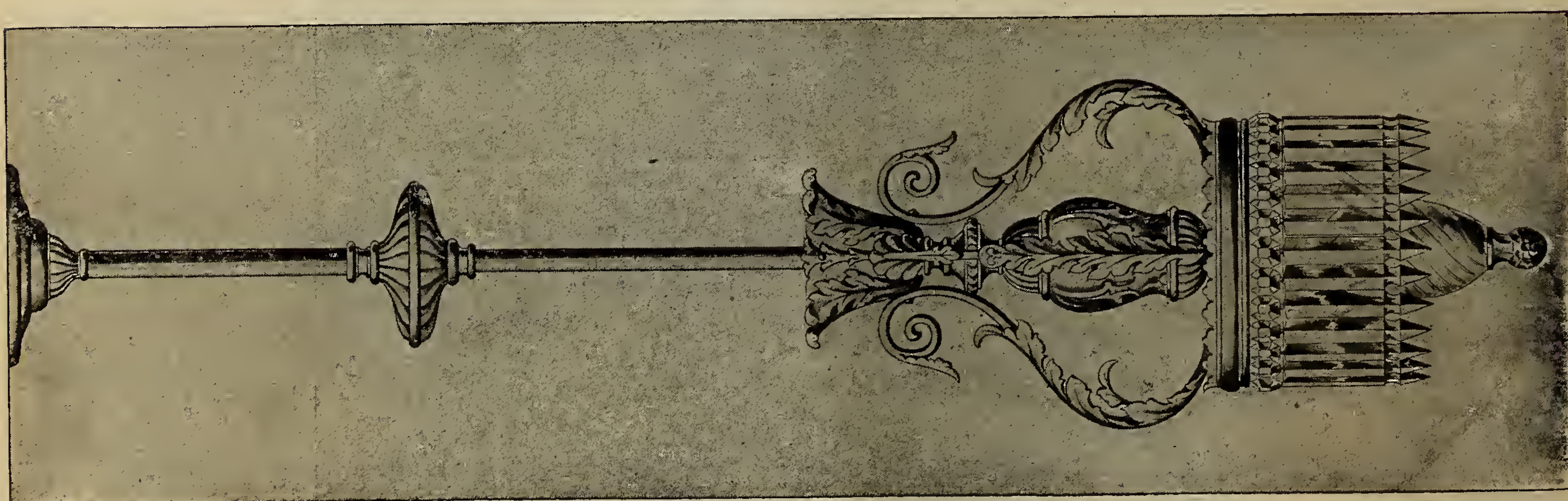
At the headquarters of the National Electric Light Convention at Niagara, Mr. G. R. Macentire, the electrical engineer and general manager of International Arc Lamp Co., had a lot of lamps on exhibition. They were looked at from a technical and artistic standpoint by all the visitors present.

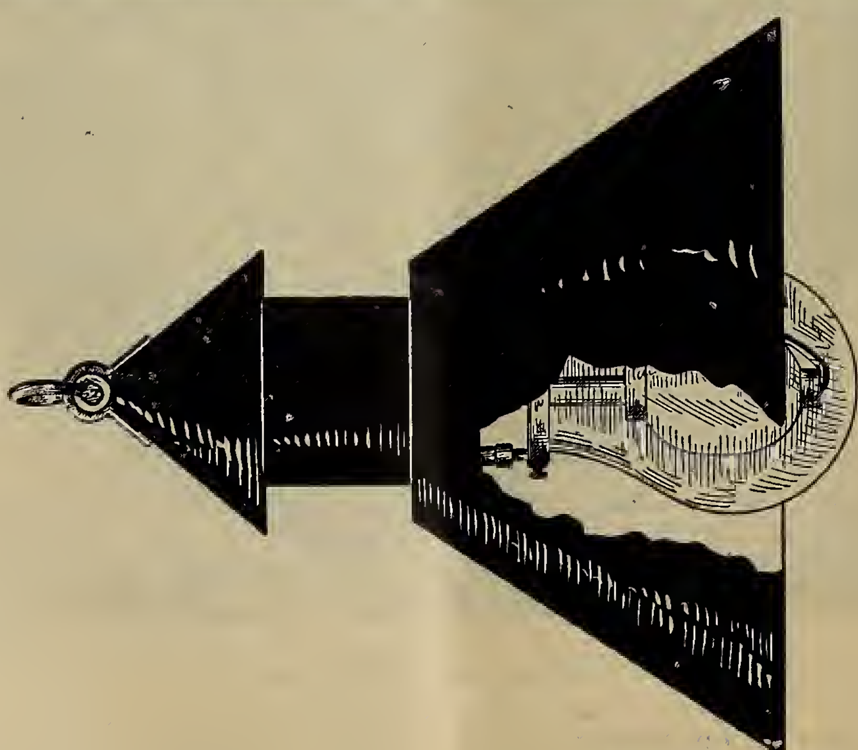
The International Arc Lamp.

The illustration, which is exactly half-size, with the ornamental globe is called "La Isabella." It is a 150-hour lamp, and is used for interior lighting. The prismatic "Arkolier" is illustrative of another beautiful

application of this new departure in arc lamps. The ready use of these lamps indoors for home lighting will institute a great change in electric lighting. Their limited field will be expanded and the great gain in efficiency and illumination will tend to place them within the parlor library and sitting room as a permanent feature. Being strongly built, well ventilated and ably protected they will last well and become a household necessity.







Lamps for Decorative Lighting, Dining Room, Parlor, etc.—International Arc Lamp Co.

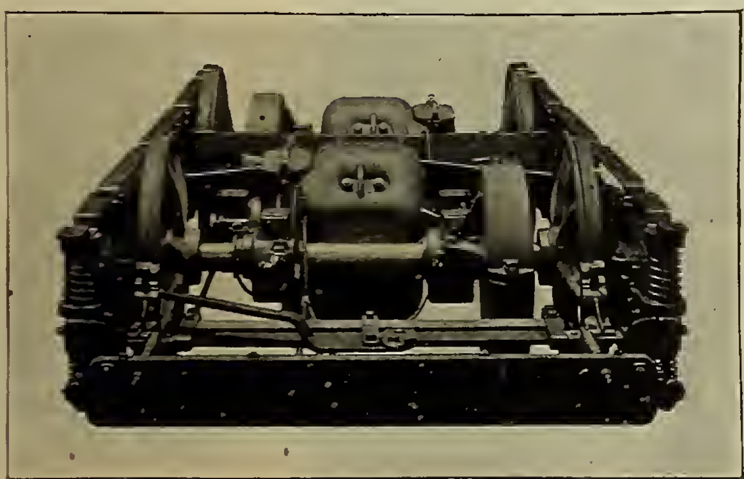
Two other illustrations are appended which show types of lamps that are absolutely new in design and novel in their application. A partial section in the shade of one enables the reader to view the interior, and form an idea of its general construction. The decoration of a large hall, theatre, etc., will be considerably assisted by the employment of these superb lamps, adding a most desirable element to the interior of such places in the shape of a handsome, compact and highly efficient source of illumination. These lamps may be used for either direct or alternating current with equal satisfaction.

ELECTRIC RAILWAYS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

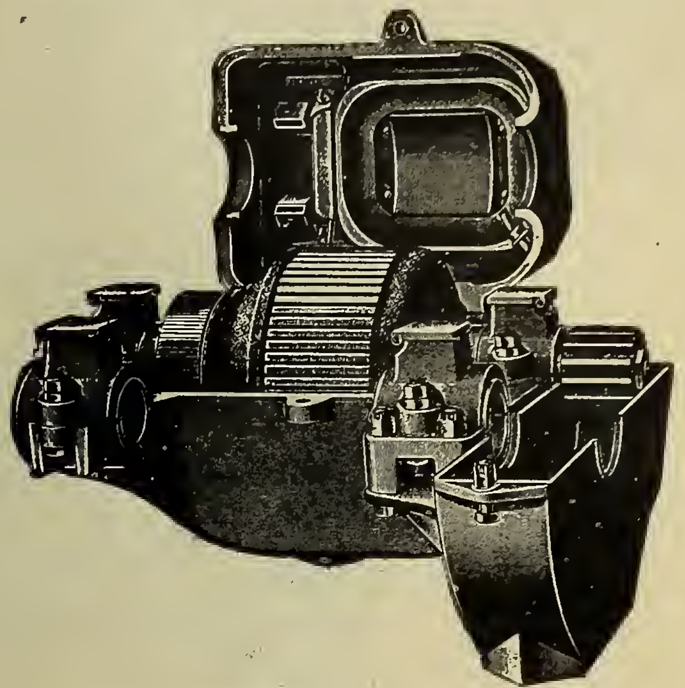
BY NEWTON HARRISON, E. E.

Many systems of railroading have been attempted in



Motor Truck.

this country. The labors and extensive experiments of Siemens in Germany, Edison, Daft and Sprague of America, were not always crowned with success. The difficulties that beset the path of the inventors, the poorness in one sense, of the mechanism, and the difficulty of obtaining the proper materials, greatly prevented them from progressing with any rapidity. The result of their efforts has been, as we well know, very successful from a practical standpoint. The electric railway of to-day is but part of a vast system that will replace all else and whose lines will reach from the Atlantic to the Pacific. The systems of railroads that have been tried with more or less satisfaction are contained in the following list:

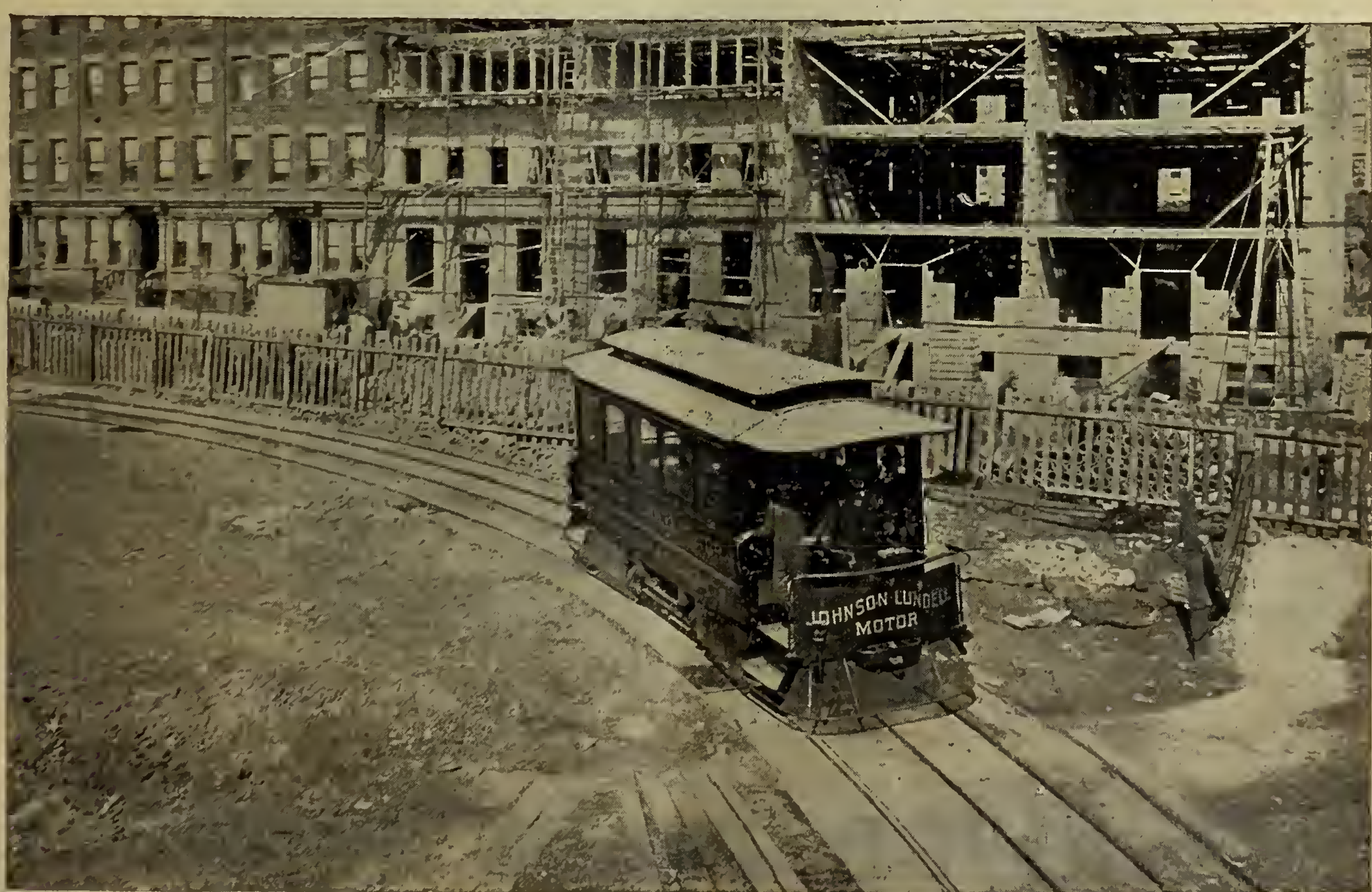


Railway Motor Exposed.

SYSTEMS:
- The Trolley,
- Conduit,
- Block,
- Storage battery.

STORAGE BATTERY CARS.

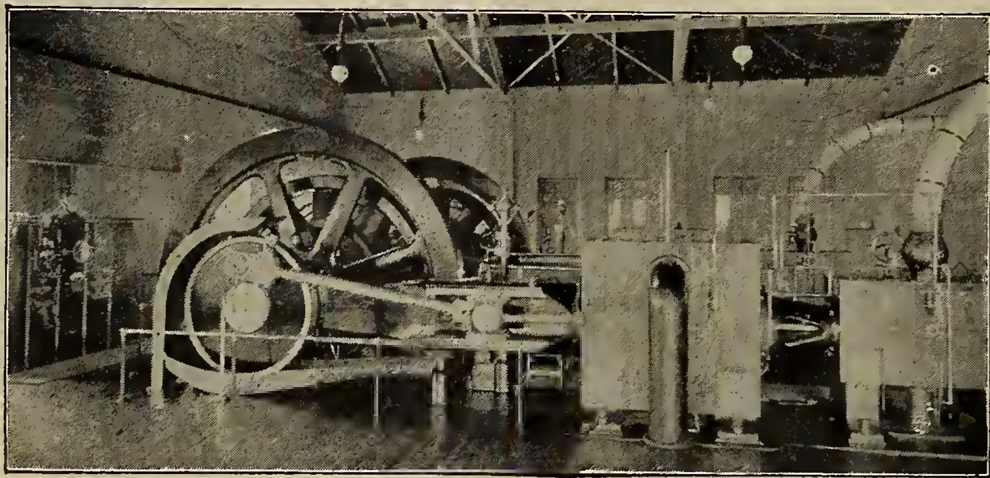
Several combinations of the above have occurred, such as a block-storage battery system of Johnson and Lundell. A method once suggested was that of having steam and dynamo plant on the train and feeding direct to the motor beneath. This was thought far superior in efficiency to the use of a steam locomotive whose record of usefulness does not exceed four per cent. The diversity of opinions existing relative to the gain and excellence of different systems hardly exist at present. The storage-



Johnson Lundell System.

battery traction method would be first-class if the storage battery were not so heavy, less troublesome to handle and a little more efficient in delivery of power. The trial made with these cells and other hybrid types has been in this city, at least, without other than temporary success. The trolley, conduit and block systems carry only the motor, but the storage-battery car moves along dragging at the same time a ton or more of cells. These cells do not pay any fare and necssitate extra contrivances for their hasty transfer from car to station or the converse. Many managers of bankrupt companies could supply eloquent testimony in relation to the subject.

joining the parts entering into the circuit. The circuit in an open conduit system is two continuous copper wires or something similar reinforced by a system of feeders, that is, auxiliary lines leading from the dynamo room or station to different parts of the line. When a set of cars takes current simultaneously from the circuit a heavy flow of current ensues. The drop of potential, calculated by the rule—drop equals current multiplied by resistance—may vary from 50 to 150 volts or more. In trolley lines the tracks being part of the circuit must be electrically joined or bonded together. The overhead line or trolley wire is the remainder of the circuit. By having



High-Speed Engine Power Plant.

CONDUIT.

Germany has enjoyed the privilege of having within its confines one of the few successful open conduit electric roads in the world. It had the first. The desire to emulate the example of German engineers caused several subscriptions in that direction which in this country last year signally failed. The development of a railroad scheme having a conduit road as its basis was looked upon as impossible. An open slot cable conduit differs in no particular from the cavity used for electrical purposes. Two conductors, insulated as carefully as possible and protected from the drippings that might corrode and injure them, are laid within side by side. A trolley wheel slide or equivalent arrangement takes current from the wire to the motor above.

As far as the running of the system is concerned, it has proven a success. The financial end is not open for public inspection. The travellers who employ the car from point to point express satisfaction, so that from a popular point of view the road is all right. The future of this road embraces that of many others. The trolley is dispensed with and the wholesome objections of municipal authorities to all external appliances. The leakage within the conduit may be brought to a minimum by having large, open and frequent sewer connections. The drainage is thus rapidly removed, and the only loss of power is that due to the moisture and condensation on the exposed wires and their supports.

DROP OF POTENTIAL.

It is necessary to appreciate the fact that the loss from leakage and the drop of potential seriously interferes with the efficiency and growth of a line. The leakage may be reduced by careful insulation, but the loss of pressure only by a successful and necessarily practical method of the tracks or rails welded or at least carefully joined the drop of potential is greatly reduced and the system infinitely improved. In trolley lines careful attention to these points will mean a saving of thousands of dollars in installation and running.

AT N. E. L. A. CONVENTION.

Messrs. J. W. Godfrey and Frank Harrington assisted Dr. Habirshaw in receiving the congratulations of their many friends. Habirshaw's wires and cables are so well known they need no description here.

J. P. McQuaide represented the National Conduit Cable Co. of New York. Mr. McQuaide needs no introduction, as he is as popular as their well-known paper, wire and cables.

The Electrical Age.

VOL. XIX., No. 25. NEW YORK, JUNE 19, 1897. WHOLE No. 527

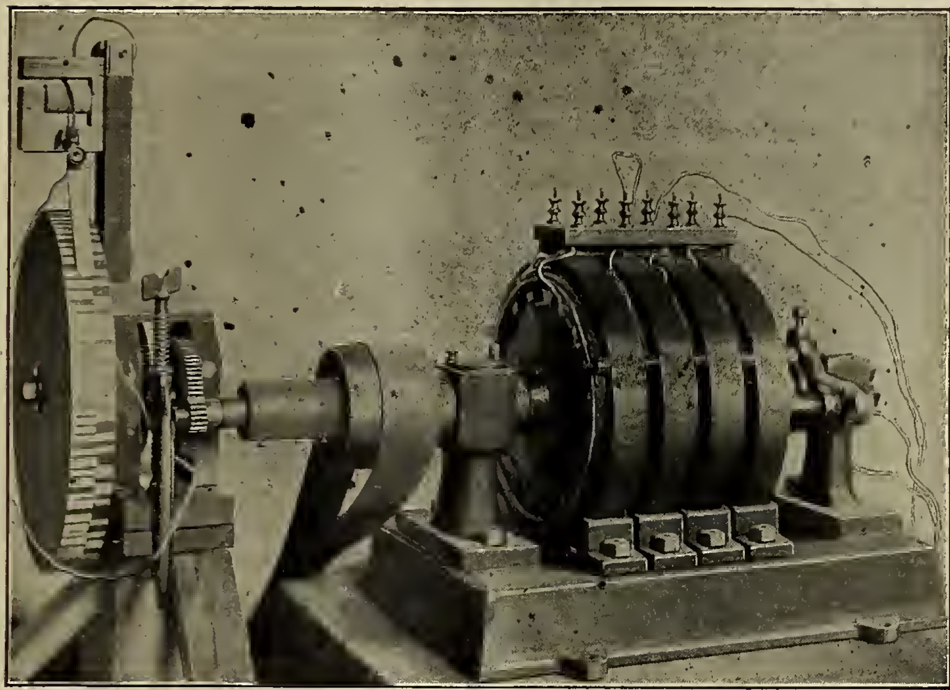


Fig. 13.—The Pupin High-Frequency Alternator, attached to Synchronous Transmitter,

Fig. 15.—Chronograph Records of the Alternating Current, under Varying Conditions of Circuit and Speed of Plate.

THE SYNCHRONOGRAPH.

(Continued from page 369.)

Since the speed of transmission depends upon the frequency of the alternating current, the limit of speed is determined by the particular alternator used. In the above example the alternator available was designed to rnn at a speed of about 1600 revolutions of the armature per minute, corresponding to a frequency of 133, or 266 alternations per second. To increase the speed of transmission, this alternator was run as high as 2400 revolutions per minute, beyond which it was thought dangerous to go. This corresponds to a frequency of about 200 complete cycles or 400 alternations per second. Through the kindness of Dr. M. I. Pupin of Columbia University, a special high-frequency alternator was loaned for the purpose of testing this system at higher speeds of transmission. This alternator, shown in Fig. 13, is in fact four alternators upon the same shaft, having 18, 22, 26,

and 30 poles respectively. To obtain the highest speed, the 30-pole machine was used, and the transmitting wheel geared to the shaft as with the ten-pole alternator. The speed of armature used was 2180 revolutions per minute, corresponding to 1090 semi-cycles per second, or 65,400 per minute, or a frequency of 545. No difficulty was experienced in sending and recording messages at this rapid rate, which corresponds to between three and four thousand words per minute.

The Polarizing Receiver.

The statement of the general principles employed in this receiver has previously been given, and it remains to describe the actual form. This instrument was designed for a military chronograph to measure the velocity of projectiles, and is known as the Polarizing Photo Chronograph.* A view of this is shown in Fig. 14.

Without giving a complete description of the instrument, which may be found in the reference cited, it will suffice to describe its essential elements. A sensitive photographic plate 12x12 inches square is carried in a metal plate holder, which revolves in the wheel W driven by the motor M. A powerful beam of light from the arc lamp, A, situated upon an inverted T-rail, O′, serving as an optical bench, is condensed by the lens, L, and passes through the polarizer, P, a Nicol prism, thence through the glass tube T, containing liquid carbon bisulphide, and surrounded by a coil of wire, through the analyzer A, a second Nicol prism. The light received through the analyzer is finally passed through a second lens L′ to focus the beam upon the horizontal radial-slit in front of the moving sensitive plate. In its operation, the analyzer A is rotated until the light is completely extinguished, when no current is passing around the tube T. The coil upon the tube is in circuit with the line from the transmitter, and the closing of the circuit at the transmitter thus sends a current around the tube, and light immediately appears upon the camera slit. This is accomplished instantly upon closing the circuit, without involving the motion of any material thing. Upon breaking the circuit the light immediately disappears, and by observing the light come and go, it is easy to read with the eye as rapidly as can be sent by hand. To produce a permanent record it is only necessary to rotate the photographic plate in the wheel W. The time required by the photographic plate to make a clear record depends largely upon the intensity of the light; but the intensity of light which it is practicable to obtain allows the time of exposure to be much shorter than is required for the purpose of a telegraph receiver. For instance, suppose the width of slit is one millimetre at a distance of 150 millimetres from the centre of revolution, and the plate rotates 1000 times per minute, the velocity of a point on the plate is 1570.8 cms. per second, and the exposure is therefore about .000063 second; for the point crosses the millimetre slit in this time. The above figures are those actually used with the chronograph in measuring the velocity of projectiles inside the bore of a gun and the records obtained are perfectly clear. The rapidity of this receiver is illustrated by stating that as many as seven observations upon a projectile inside the bore of a U. S. 3.2-inch breech-loading field rifle have been recorded in the first 57 centimetres (1 foot 10½ inches) of its travel, and observations as near together as 3.8 cms. (1½ inches) have been obtained. These correspond in time to intervals less than a thousandth of a second, or they bear about the same relation to a second as a second does to a third of an hour.

In chronography as applied to gunnery, since the agent which operates upon the transmitter circuit is the projectile itself making and breaking the circuit by passing through screens, evidently if the screens are properly placed according to a code, a message could be transmitted to the receiver by a projectile in its flight.

* "The New Polarizing Photo-Chronograph," Crehore and Squier. John Wiley & Sons, New York, 1897. Chapman and Hall Ltd., London.

The Chemical Receiver.

In a practical form of receiver, it is an advantage to have the messages received in such form that they are ready for immediate use, and this is the case with the chemical receiver to which reference has already been made.

Through the kindness of Mr. Delany, some of the sensitive paper tape used in his system of machine telegraphy was obtained for experiments with the synchronous transmitter. A simple method of obtaining records of currents with this tape, which is certain in its action and does not involve any special apparatus, is to place the tape upon a smooth metal surface, which serves as one electrode, and to draw a steel needle, serving as the other electrode, along it guided by the straight edge of a ruler. If a direct current is used, no record appears when the current is in one direction, and it does appear when the current is reversed. If a second needle is substituted for the plate electrode, the record appears on one side of the tape for a direct current and on the other side for the reversed current.

If the two needle electrodes are placed side by side upon the tape, a record will appear at one needle for a direct current, and at the other for the reversed current. Employing the alternating current with the single needle and plate as electrodes, the record shows a regular succession of distinct marks, separated from each other by equal intervals. Each mark exhibits an intensity varying approximately according to the sine curve. Since by this arrangement the current makes its record in one direction, only the result is that alternate semi-cycles of the current are suppressed, and alternate ones are recorded.

By receiving with two needles side by side, all the alternations are recorded, those that were suppressed before now appearing at the second needle. The record then appears as two parallel lines of marks having the maximum intensities in one line opposite the spaces in the other. Using the transmitter as already described with a semi-cycle as a unit in preparing the tape, and receiving in two lines, it is found that some of the marks are omitted in one line and some in the other, and to facilitate translating it is simpler to bring the two lines into coincidence to observe the dots and dashes of the message. A message was then prepared upon the transmitter wheel, using a complete cycle as a unit, instead of a semi-cycle. When received in a single line this message is complete, no matter to which terminal of the circuit the receiving needle is connected, because each unit now contains both a direct and a reversed current, one of which will record.

(To be continued.)

RAILWAY MOTORS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The great increase of electric roads in this country clearly shows that the experimental stage has been passed. There have been many millions of dollars invested in this species of traction that have proved a source of profit to the capitalist. In the steam railroads of this country a decrease of thirty-three millions of dollars has taken place in passenger receipts.

The essential parts of a railway installation may be enumerated as—

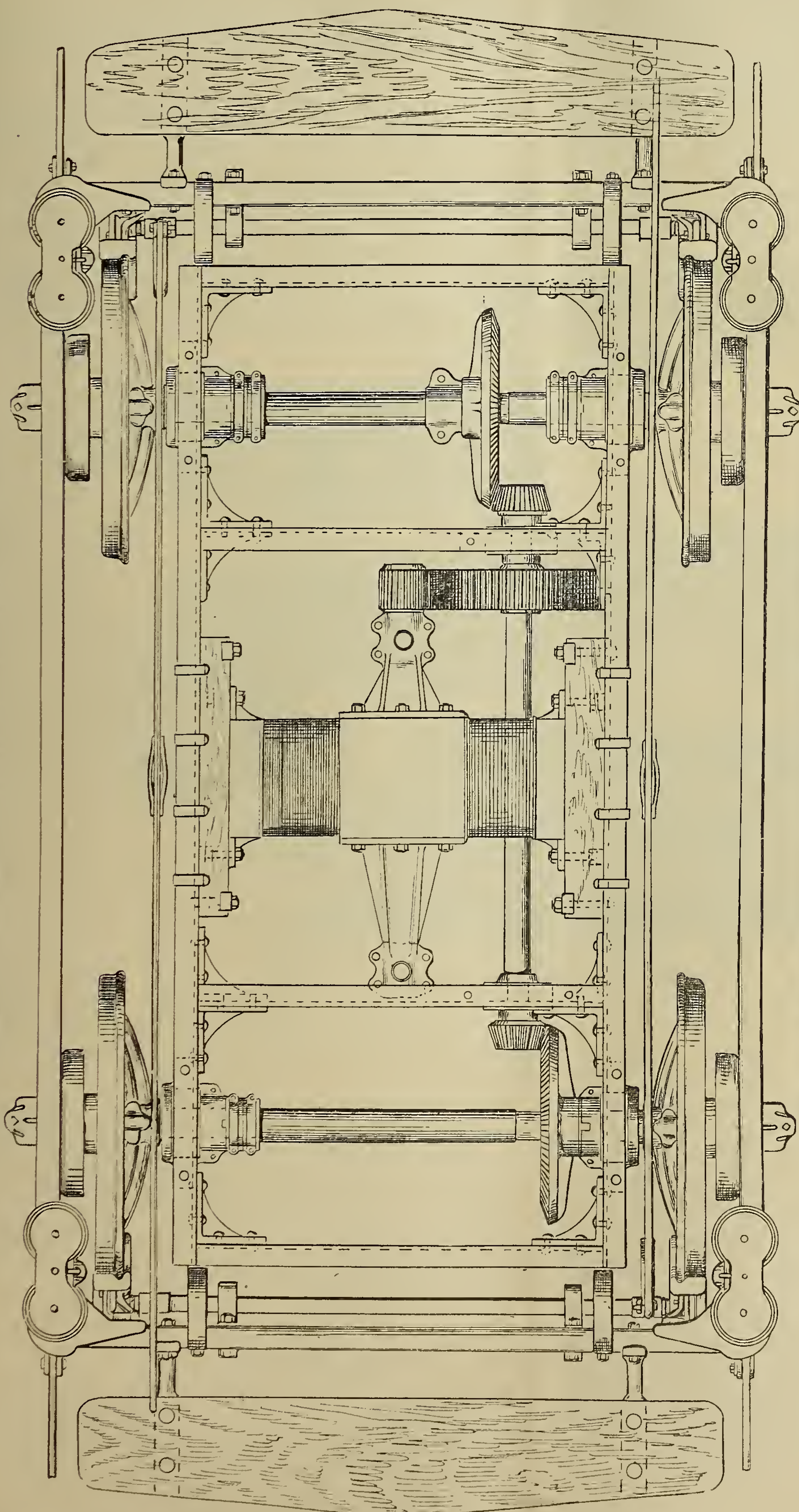
Power house,

Track,

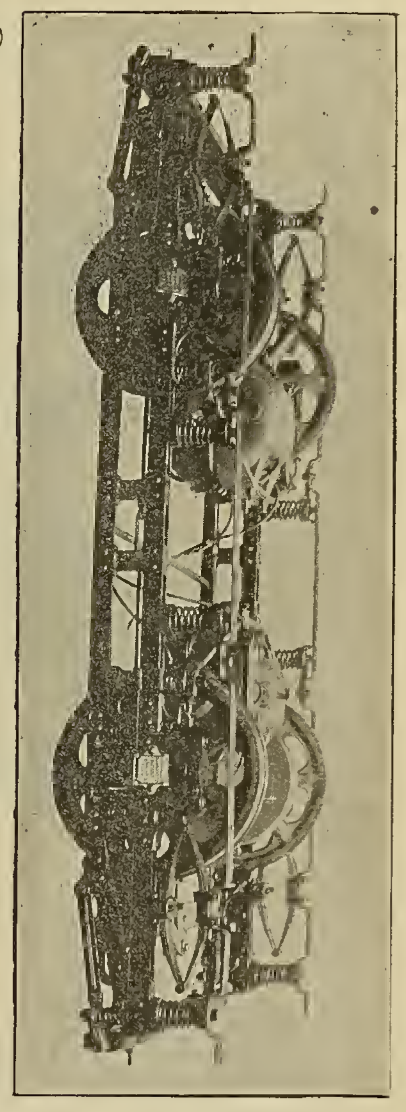
Car equipment.

Each of these constitute a department of engineering that calls upon the greatest skill and experience to perfect.

imagine it a bottomless pit for all their wealth. On the other hand the great assistance given by an economically run power house to the yearly receipts will evince itself by the fact that dividends will be frequently and liberally distributed.



Plan of Early Motor Car Equipped with Double Reduction Gearing.



Modern Motor Truck.

Power House.—In the power house losses may occur which will at the end of the year be so effective in reducing the earnings of the road that its stockholders will

To make a power house pay, or to run it under conditions that are favorable, an examination of the

Fuel,

Boilers,
Engines,
Dynamos,
Labor,

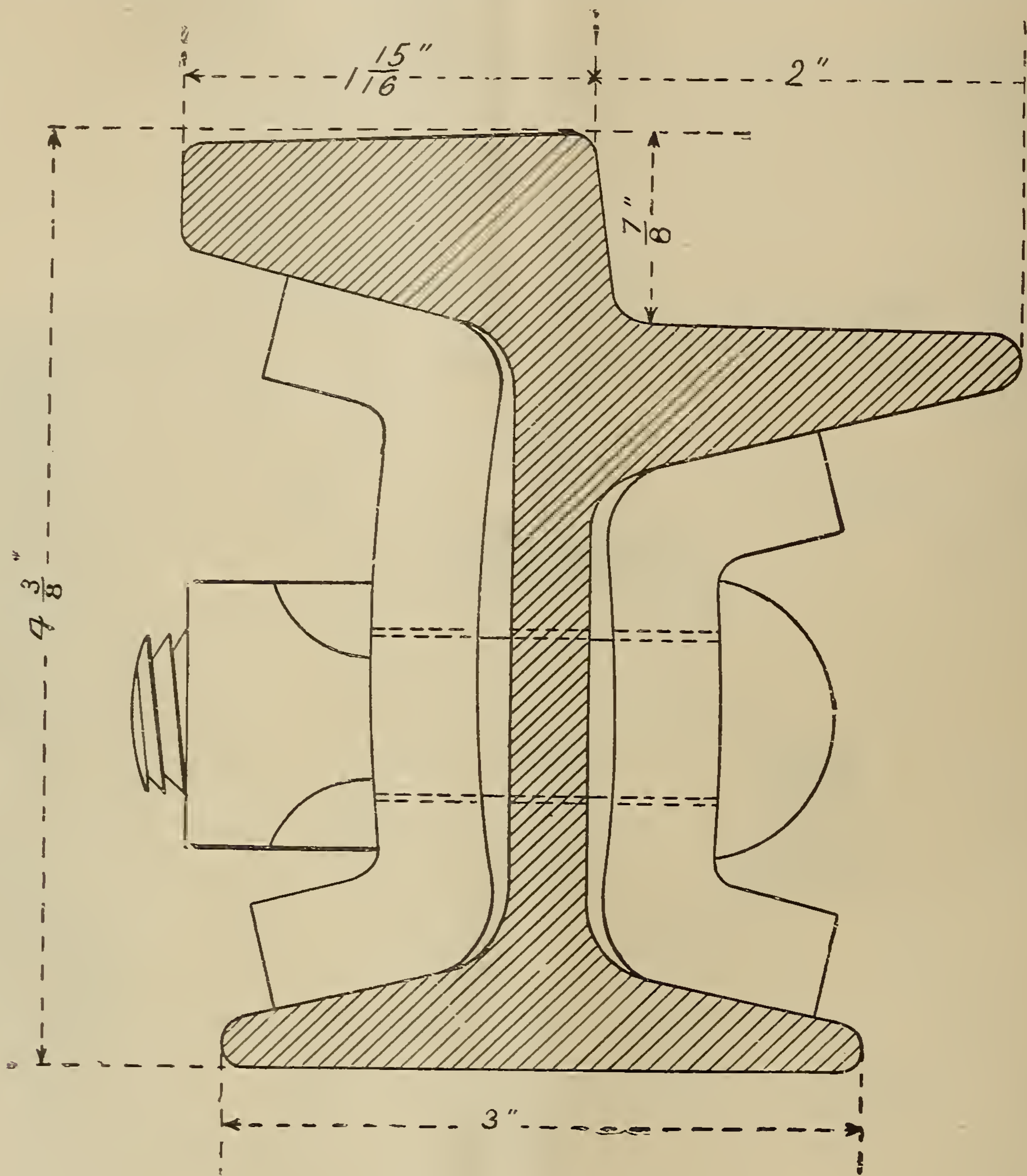
must be successively made. It may so occur that the machinery installed requires too much attendance and a large salary list in the consequence. Repairs and additions are of consequence in addition. The cost of fuel is so very important an item to consider that it may well be said that its consumption determines the expense of operating the plant. Coal is costly because it requires transportation; the less there is of this the more money is saved. Boilers have been so improved that it is possible to burn the refuse of coal heaps, the culm that aggregates in tons near every mine. The cheapness of the fuel depends upon the location of the power house. If electric light stations were situated near large mines the power would be much cheaper than at present, provided the scale of distribution was large enough. To produce the current with economy the station must be near the railroad or mine and consume cheap fuel.

Limits of distance are of course to be considered. The cost of feeders, etc., in an installation whose power house is far removed from the track would be considerable.

Boilers.—The boilers used must be of a kind that can consume cheap grades of coal, that will not be difficult to clean, and whose soot is not so considerable that their use is impossible. The nature of the water may have a serious effect upon the boiler; briny water leaving heavy deposits behind, the removal of which endangers the boiler shell.

Engines.—In earlier days engines that would do considerable work, but in a wasteful manner were employed. On modern engines an indicator card shows changes going on within; whether the steam is entering in quantity and not properly expanding, or whether the required amount enters and delivers up its energy. In other words, the engine of a power house should use its steam to the best possible advantage. The frequent and heavy changes of load must be met without incurring changes of speed. The point at which the steam is cut off should touch as much upon the point of economical expansion as upon the point of sufficiency for heavy demands of power.

It is generally conceded that steam tends to expand differently with different pressures; it is therefore best to allow expansion to occur to an extent compatible with each particular pressure. The experience of the engineer will lead him to this point in daily practice.



Section of Standard Rail.

It is not the quantity of steam generated or the amount consumed by the engine that brings economy, but the extent of its expansion.

Track.—Power is wasted in the outside of the station as well as within. It may be lost due to

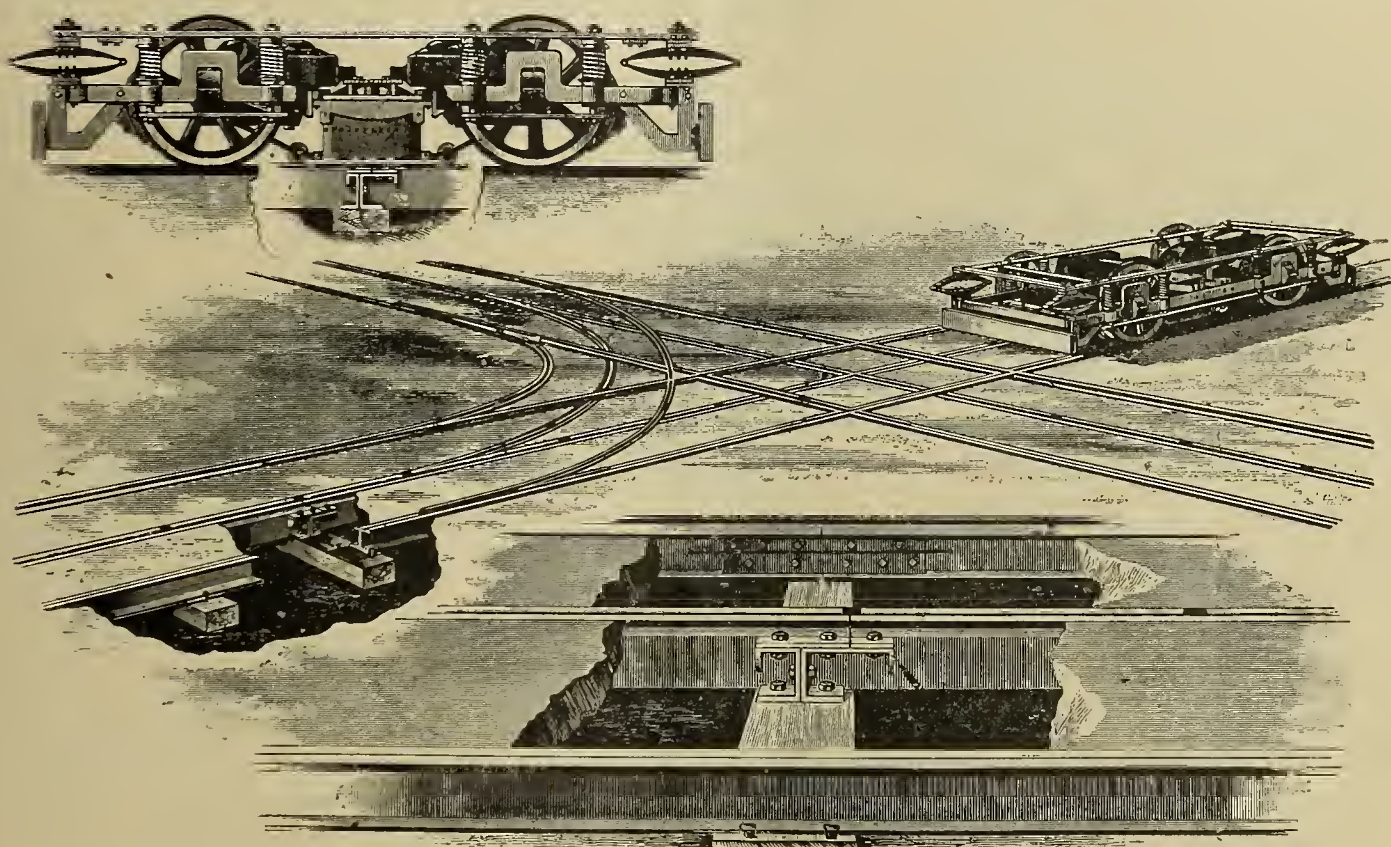
Leakage,
Poor bonding,
Bad feeding,
Inefficient motors.

The leakage is a matter of insulation; to keep the road free from heavy grounds is a matter that is neither difficult nor impossible, if ordinary care be bestowed upon it. The bonding of the track is the connecting of one rail to another by a conductor of sufficient size to prevent a drop of potential at each junction. The fish-plates connecting rail to rail are not sufficiently good. Copper conductors are used in addition; as they corrode and otherwise deteriorate, the loss may be considerable. They

introduce resistance, lose pressure and waste power if not properly installed and attended to.

The trolley line is supported at intervals along the line by feeders—heavy copper conductors that run from the power house to different points of the line. The tracks, if well bonded with copper, being grounded, will be an excellent return. The trolley line is not so well situated; it depends upon the feeders for the maintenance of its pressure, and these feeders will have to be heavier the poorer the bonds.

Motors.—The efficiency of the motors is a point of great consequence in the outfitting of a railroad. The two electrical features are the generator and the car motors. If each were of an average working efficiency of 80 per cent., without considering other losses the balance of power would be 64 per cent.; additional drains due to leakage, bonding, feeding station losses, etc., would reduce these figures in practice to about 40 to 45 per cent. as the total efficiency of installation. Motors that do not wear well because of bad design will be a continual source of trouble. This item of expense, repairs, must be kept down to its lowest point and can only be reduced by using motors that represent the best design and practice of the day.



McLaughlin's Conduit System.

LECTURE ON THE DIRECT CONVERSION OF ELECTRICITY FROM HEAT.

(Continued from page 373.)

The cross connection piece is made of copper. I have no necessity for concealing the metals used, for it is simply in my treatment of the metals which makes them tough, easily handled, and not liable to rupture, and useful as practical couples.

But to get to the subject of the couple, for that is the real starting-point of the device. We make them now by machinery. There is no soldering or brazing or joining, except a machine joint. The castings are made in a special room, the room being heated up to a considerable temperature, and it is quite disagreeable to stop in the room. All the work is done under as high a heat as it is possible for the men to stand. The cross connection parts are dropped into the machine and the couples are made quicker than it would be possible for me to walk from here to the door; not only one but fifteen are made in that time. It is impossible to count five, I suppose, before the casting is made complete in all its joints, and we are now, or will in a very short time, be running a machine that will make a casting which goes from the bottom of this device clear to its top, with absolutely no joint in the entire device. In making this casting, it is not a jointing of this cross strip with this lag, as we term it in shop parlance, but it is a shading of one thing into the other. Just as if we take a heavy bar here, and a light bar here (indicating), there is a distinct connection; but if we shade this down here (indicating), and again bring it down here, there is really no line of demarcation, no line where there is a joint. Perhaps it would be best to consider this as having been spread out to take a heavy line here and an entirely different line there, there is the line of demarcation. We do away with that line, and shade it off from one into the other, gradually shade from one line to the other, so that there is no line of demarcation; if there was a line of demarcation there could always be a possibility of oxidation, separation or disintegration. If there is no line of demarcation, it is impossible even to imagine where there might be the possibility of rupture.

In thermo-electric couples the fact has been conceded that if we had a couple like this (indicating) the closer we could get to the surface, the higher the electromotive force. I do not find it so. Instead of putting our junction there, we turn this cross connection piece (indicating) down into the element, that way, and turn the opposite piece up that way, which you can see would very materially tend towards lowering the internal resistance of this lug, and we find no decrease in the electrical output from the standpoint of the electromotive force. This is contrary to the way thermo-electric elements have been made.

After these thermo-electric castings are made we subject them to a bridge test. We make a bridge measurement of it to get the internal resistance when it is cold. Strange to say, these thermo-electric couples as built give a current at all times absolutely independent of the fact whether you apply heat or not. There is a difference of potential indicated at all times by a casting of these thermo-electric couples. When we find this natural current in our testing we offer it in this way. If the current, for instance, is in this direction (indicating), we place a hand in the neighborhood of the casting and bring the galvanometer needle to a balance. If the current is in the opposite direction we place the hand here (indicating) until

we bring the needle to a balance. Now, after we have produced the casting, and after we have tested it in the way described, we form the castings up on a spindle and braze the connection of the castings together; using five castings with a total of seventy-five junctions, made in five different operations, which take about, I should say, a total of ten minutes to produce the entire number required. This brings us to the first point in the construction of the machine. We term it a machine. We label this (indicating) as having an internal resistance of so much. After these couples are built up, we cement the interior with vitrified cement. When it is all cemented, the plates which have held this built up device are retained, and it is put in the oven and baked and vitrified. It is then tested again; and all this time it has the tag on which it started with, which indicates the internal resistance of it when first built up, and the internal resistance of it in the various processes of its manufacture. It started with first being baked in the interior; that is the first baking; then we cement the outside of the machine, bake it and check the resistance again; all bridge measurements having for their object the substantiation of the fact that the internal resistance has not changed—has not increased or decreased. It is simply to substantiate the original value of these five castings, which go to make up the machine. Now we have cemented the inside and outside. Then we cement the top and the bottom, and put it through another bridge measurement when it comes out of the oven. If it passes that bridge measurement its jacket of metal is cemented on and firmly joined to it, and it becomes a hard stone cylinder firmly joined to it, and the copper has become so closely connected with it that it becomes an integral part of the cement and of the machine itself.

(To be continued.)

The power house of the Cincinnati Edison Electric Light Company on Eighth street is to be abandoned, and not later than the 1st of July that company will commence the erection of a power house which, Mr. J. I. Beggs, the general manager says, will be equal to any electrical power station in the world. The negotiations for the property on which the power house is to be erected are well under way, and will likely be closed within a week, but the location of the new plant will not be disclosed until the deed for the property is made out to the company. These matters were decided upon yesterday at the annual meeting of the stockholders, and it was also decided to increase the capital stock of the company from $1,285,000 to $2,000,000, in order to secure the funds necessary for the contemplated improvement of the company's service. The election of directors resulted as follows: John I. Beggs, L. C. Black, W. N. Cromwell, Lowe Emerson, J. B. Foraker, C. A. Gordon, A. Marcus, C. E. Prior, Geo. R. Sheldon, C. A. Spofford, C. W. Wetmore.

AMERICAN IMPULSE WHEEL CO.

In our issue of April 17 we gave a description of the Cazin power wheel manufactured by the American Impulse Co., 120–122 Liberty street, New York. The installation of impulse water-wheels in connection with electrical power transmission has become a general practice, and electricians have shown an eagerness for taking hold of whatever improvements are being made in the line of water wheels for the purpose of increasing their efficiency.

The manufacturers of the Cazin power wheel have issued a general challenge (see page 42 of their pamphlet) to the manufacturers of any or all other impulse wheels for a comparative test before impartial competent judges, but as yet none of them has accepted this challenge and the engineering fraternity have to rely on their own wits in the matter of realizing whether the claimed superior merits were in fact incorporated in the new wheel.

We find therein the following expressions:

"In the mounted impulse wheel there may be consid-

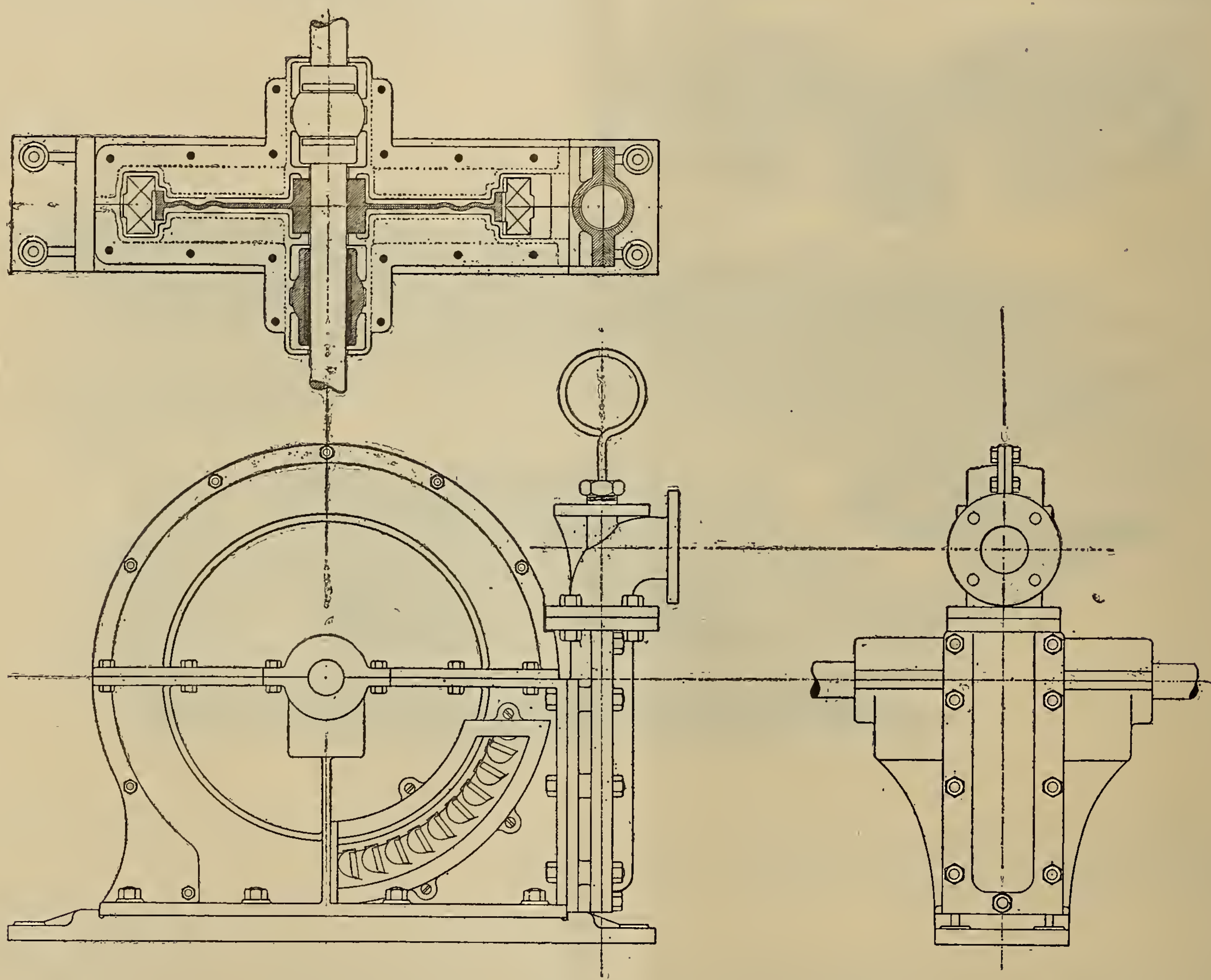


Fig. 1.

(Continued on Page 392.)

The Electrical Age.

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NEWTON HARRISON, E. E., Sec'y, Treas. and Editor.

ADDRESS ALL COMMUNICATIONS TO
THE ELECTRICAL AGE PUBLISHING COMPANY,
FIRST FLOOR, WORLD BUILDING.
NEW YORK.

NEW YORK, JUNE 19, 1897.

CONTENTS.

EFFECT OF ELECTRICITY UPON PLANT LIFE.

It is Huxley the scientist who states that our vitality or vital force is merely the transformed energy of a lot of inorganic matter which has been absorbed and assimilated by the plant, and within ourselves becomes human power, muscular strength and brain tissue. To consider ourselves as mere organized masses, permeated, so to speak, with the molecular forces of phosphorus, lime, sulphur and iron is somewhat repulsive to the spiritual-minded, yet as a fact it stands unabashed in the light of criticism.

It may therefore be accepted by the reflective mind that if the living power of living things, of all organisms, depends entirely upon the latent forces residing in matter, then perhaps these forces to which we are forever tied may be able to affect an organism in their turn—possibly mould its future growth, if applied in time, or exercise a marked effect npon its development and rate of growth. In a past editorial published in the Electrical Age mention was made of a most remarkable experiment in relation to an egg that was being hatched. It was found that an electric current of sufficient strength to kill the fowl was not capable of destroying the vitality of the germ residing within the egg. But it was subsequently noticed that the chicken when hatched was of abnormal shape, monstrous in appearance, and indicated physically the severity of the cause that had destroyed its normal appearance. These facts are interesting in so far as they tend to prove that the organization of a growing thing is influenced by the impress of a force upon it before it reaches maturity.

The Massachusetts Agricultural College have proved that in certain respects electricity stimulates the growth of plants. Mr. Asa S. Kinney, an expert in agriculture, has made a series of experiments which extend over a period of three or four years. They prove that a seed planted in the ground does not grow as quickly as one artificially rushed in its development by the use of electricity. The method followed is this: Two lots of twelve groups, each made up of one hundred and twelve seeds. They were well soaked in water and then placed in glass vessels open at each end. The receptacles were of cylindrical shape and had dipping into them copper disks, to which a current was applied for several minutes. The seeds were planted after this and kept at a temperature of from 45 to 50 degrees. Expressed numerically the seeds planted in the ordinary manner lacked rapidity of growth to the extent of thirty per cent., that is to say, the seeds treated electrically in the manner described grew 30 per cent. quicker than those treated in the regular manner.

The experiments were performed in the botanical laboratory of the agricultural college, and were carried on without fear of interruption or possibility of error.

Three general objects were held in view, (1) To determine whether the seed could be influenced by the current. (2) To find out whether the action occurring was beneficial or injurious to the seed. (3) To qualify, so as to decide upon the proper strength of current to use. The experiments were of a more scientific than practical character, yet the results obtained show that the use of electricity may save the farmer and agriculturalist considerable money in the course of five years by enabling him to start the growth of seeds in the manner described before planting.

A great percentage of the seeds are wasted, as a rule, and no effort is ever made to save them; they rot in the ground or dry up on the outside. By the above process germination is started beforehand, thus increasing the chances of growth and maturity immeasurably. The apparatus used was constructed with two plates, one of porcelain outside, and an inner one of clay, six or seven inches in diameter. The inner plate carried filter paper. The outer plate was constantly supplied with water, which eventually permeated the porous plate and kept it damp. Seeds were thrown upon the filter paper and another piece of filter paper placed on top. The whole was kept in darkness. Leclanche cells were used for the supply of current, as the current was never allowed to flow for more than five minutes. A Ruhmkorff coil was connected to the cells, the seeds being stimulated by a high tension discharge.

An electric clock performed the service automatically of allowing current to affect the seeds once an hour for about thirty seconds. Slow growing seeds were readily affected by the current, growing rapidly after the treatment.

Philadelphia, June 5, 1897.

Electrical Age Pub. Co.

Dear Sirs: Self-oiling bearings seem to be in general use for dynamo motors, etc. Have any of the manufacturers ever made use of graphite bearings? I have experimented a little on that line and believe I have struck a good thing. Is there any particular benefit gained by oiling a graphite bearing?

Yours truly,
M. Beeler.

(A.)—A self-oiling bearing is the best thing to use. Graphite bearings or graphite bushings are not the best means of securing ease of running. A graphite bearing that is lubricated with oil has lost its initial object, that is, independent lubrication. A babbitt metal bearing oiled is better than a combination of oil and graphite.

ered three sources of loss, the nozzle not being considered a part.

1. Loss due to non-reversal of stream.

2. Loss due to mechanical action, interference of particles and friction of water on the surface of the buckets.

3. Loss due to friction of the wheel in its bearings.

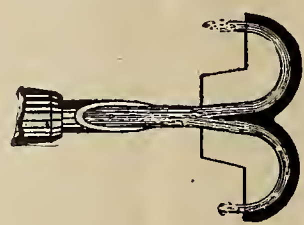


Fig. 3.

No clearer exposition of the main causes of loss of efficiency in an impulse wheel driven by force jets could possibly be given than the one just quoted. On the other hand, the following facts might be considered as removing all doubt in the present test.

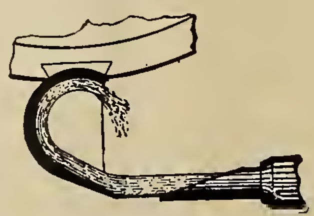


Fig. 4.

1. That in the Cazin wheel the reversal of the stream is complete and continuous on a parallel line to injection, as due to the patented figuration of the Cazin vane, which, unless patent right has no meaning, cannot be achieved by any one of the other vanes.

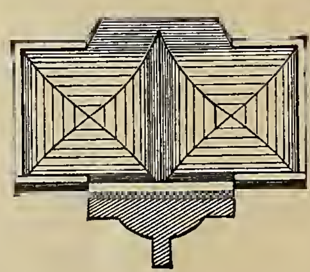


Fig. 5.

2. Solid particles being ejected against the wheel vanes, cause additional friction, whenever there is in the course of the liquid, when in contact with the vane, what Bodmer calls "abrupt curvature" or a "non-continuous curve," but when the solid particles partaking in the velocity of the jet and surrounded by the liquid medium follow, virtually as a part of the liquid, its course on true curves and their tangents, no additional friction is experienced. In the Cazin power wheel the entire figuration of the vane is a combination of true curves and tangents.

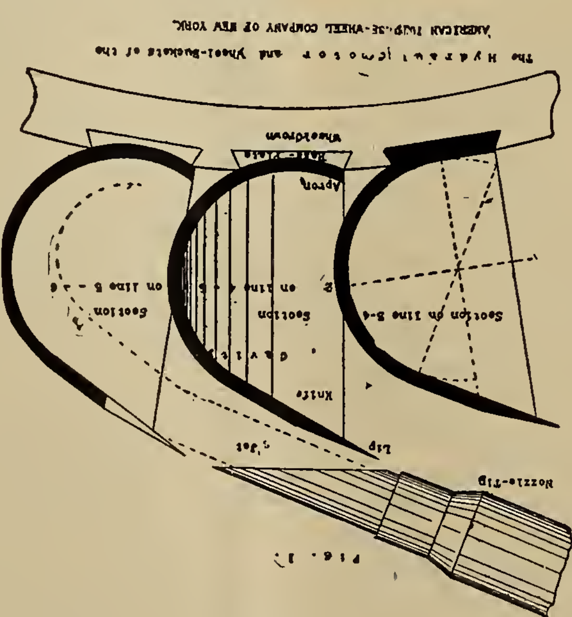


Fig. 2.

3. In the Cazin power wheel only the most improved kinds of bearings (globular and self-lubricating) are made use of, and if there were any better in existence, its manufacturers would surely adopt them as others might, leaving no difference on this score.

But the author referred to has overlooked a fourth possible source of loss of efficiency, which fourth source consists in a possible or eventual diversion of the jet direction without benefit, as the means of power transmission. Such useless diversion may possibly result from the jets striking any part of the exterior of the vane, giving a slanting direction to the jet or a part of the jet.

The illustrations represent two competing impulse wheels and permit a comparison in the matter of such possible diversion. Fig. 1 shows the Cazin power wheel in its standard form, with the nozzles, jets and a number of vanes in plain view.

Figs. 2, 3, show details of jet impact and vanes.

Fig. 5 shows a front view of a vane.

Fig. 6 shows the general arrangement of one of the older forms of impulse wheels.

The same Cazin wheel is made to serve as rotary steam engine by supplying the nozzle with pressure-steam in place of water under head, and be made to serve as water—and steam wheels simultaneously, by providing steam—nozzles diagonally opposite the water-nozzles.

SPECIAL NOTICE TO TRADE AND CONSUMERS.

Discharged ex-employés of this cōmpany are making false claims as to the founding of The Peerless Rubber Manufacturing Co., 16 Warren street, New York, and the manufacture of its goods. For the benefit of the public we will say that this company was founded in the year 1872 by Charles Foster, Jr., and Henry S. Winans, who associated with themselves as superintendent Mr. John H. Deming, who has had entire charge of the manufacturing department. Mr. Deming has been with this company continuously since 1872, and is at present our general superintendent. He has had thirty-four years' continuous experience in the manufacture of fine mechanical rubber goods. This long experience places Mr. Deming in the front rank of manufacturers. They believe him to be without a peer.

Rainbow packing was suggested by a prominent merchant to C. H. Dale, then general sales agent, and with all other goods made by this company was introduced to the trade solely by Mr. Dale, and Mr. John H. Deming is the only man who has ever manufactured Rainbow packing, and is the only man who knows how. We would also say that Mr. Deming is the only superintendent this company has employed, or had in its employ as superintendent, since it was founded in 1872. All other claims are false.

Peerless Rubber Mfg. Co.,
C. H. Dale,
President and General Manager.

SOME ELECTRICAL ANCESTORS.

By Associated Trade and Industrial Press.

Washington, D. C., April, 1897. The preservation of old inventions or models of them, is a good idea. It not only honors the inventor, who so often gets but little more than honor for his work, but preserves to posterity the links of the valuable chain of inventive progress.

In a portion of the National Museum of this city, one is taken a long way back in the matter of electrical inventions; and he sees there, among other things, some of the original work of that old pioneer in electrics, Professor Joseph Henry, the first secretary of the institution. One of the very interesting objects exhibited is the little sound-maker which gave voice to electric force in 1830, when Professor Henry was carrying on experiments at the Albany Academy. This little instrument is the father of the electro-magnetic telegraph, for it was the first of its kind used to demonstrate the idea that sound could be produced at a distance through the medium of battery wire and magnet.

In operating this invention, a permanently-magnetized steel bar was used. This was mounted upon a pivot, so that one end would swing between the two arms of a horseshoe-magnet which, when excited by a current from the battery, attracted the bar causing its outer end to strike a small bell. The wire used in the experiment was one mile in length, arranged about ten inches long by two inches wide and the steel bar about ten inches long.

A model of Henry's intensity magnet is in the collection. It (the magnet) was made in 1820, and is now at Princeton. In making this magnet a long coil of wire was used and was connected with an intensity battery, from which it took its name. In speaking of this apparatus Mr. Henry says:

"I was the first to point out in my paper in Silliman's Journal that when magnetism was to be developed by means of a compound battery, one long coil must be employed, and when the maximum effect was to be produced by a single battery, a number of single strands must be used.

Telegraphy owes much to this old magnet, for by it was shown the possibility of transmitting signals to a distance; of ringing bells and making dots.

The discovery of the "extra current" was made by Professor Henry in 1829; and when he took up the subject of electro-magnetism from Sturgeon's "infant" electro-magnet, he immediately employed insulated wire, with which to conduct experiments. He also gave attention to inductions at a distance (something which is attracting so much attention in the electrical world today), and obtained results which would have delighted that glorious old philosopher Benjamin Franklin. In speaking of these experiments, Mr. Henry says:

"I connected a copper wire to the roof of the house and passed the lower extremity into a well; the wire was divided near the window, and a compound spiral inserted. I placed a needle in the spirals; at each distinct flash from a thunder cloud the needle was rendered magnetic: one of these at a distance of eight miles" from the cloud.

In the electrical exhibit is the old Morse telegraphic instrument used on the Baltimore end of the first wire employed in sending messages to a distance. Not far from this venerable invention is a model of a plow made by Morse and intended to be used in making trenches in which to lay the Washington and Baltimore wire. Mr. Morse desired to first put the wire in lead pipe and then bury it in the ground. But this idea was abandoned after due consideration, and the wire was strung upon poles. The plow has a reel on top of its shaft, from which the wire was to be reeled and guided into the trench as the plow was forced along through the soil.

A specimen of the earliest type of Brush-Swan electric storage battery is seen in the collection. It consists of one cell only, is about two feet square and four inches wide, and is a part of a battery of twenty cells used for incandescent electric lighting in the National Museum from 1883 to 1886.

The Museum possesses some models of electric motors and one (a genuine old "ancestor") which accomplished wonders in the way of speed. This motor which now lies outside the Museum Building is the invention of D. G. Weems, who said that it developed a speed of one hundred and twenty miles an hour. This was accomplished on a circular track, two miles in circumference, near Laurel, Maryland. These speed tests were made nearly twenty years ago.

The motor car which made such fast time, is 16 feet long, 24 inches high and 30 inches wide. The head is pyramid-shape, and the weight about three tons. At each side of the two axles a twenty horse-power motor worked, with the armature wound directly over the axle. The current came from a central power to a conductor over the track, thence through a brush, kept in spring-contact with the conductor to the motors. To complete the circuit the electric fluid, after reaching the motor, flowed down to the track and was led back to the central station by a return wire. This apparatus was not a success from a practical standpoint, but it demonstrated the value of electricity as a speed-maker.

Buffalo, N. Y.—R. G. Parsons, secretary Board of Public Works, may be addressed concerning establishment of an electric light plant at the pumping station of the bureau of water, foot of Massachusetts street.

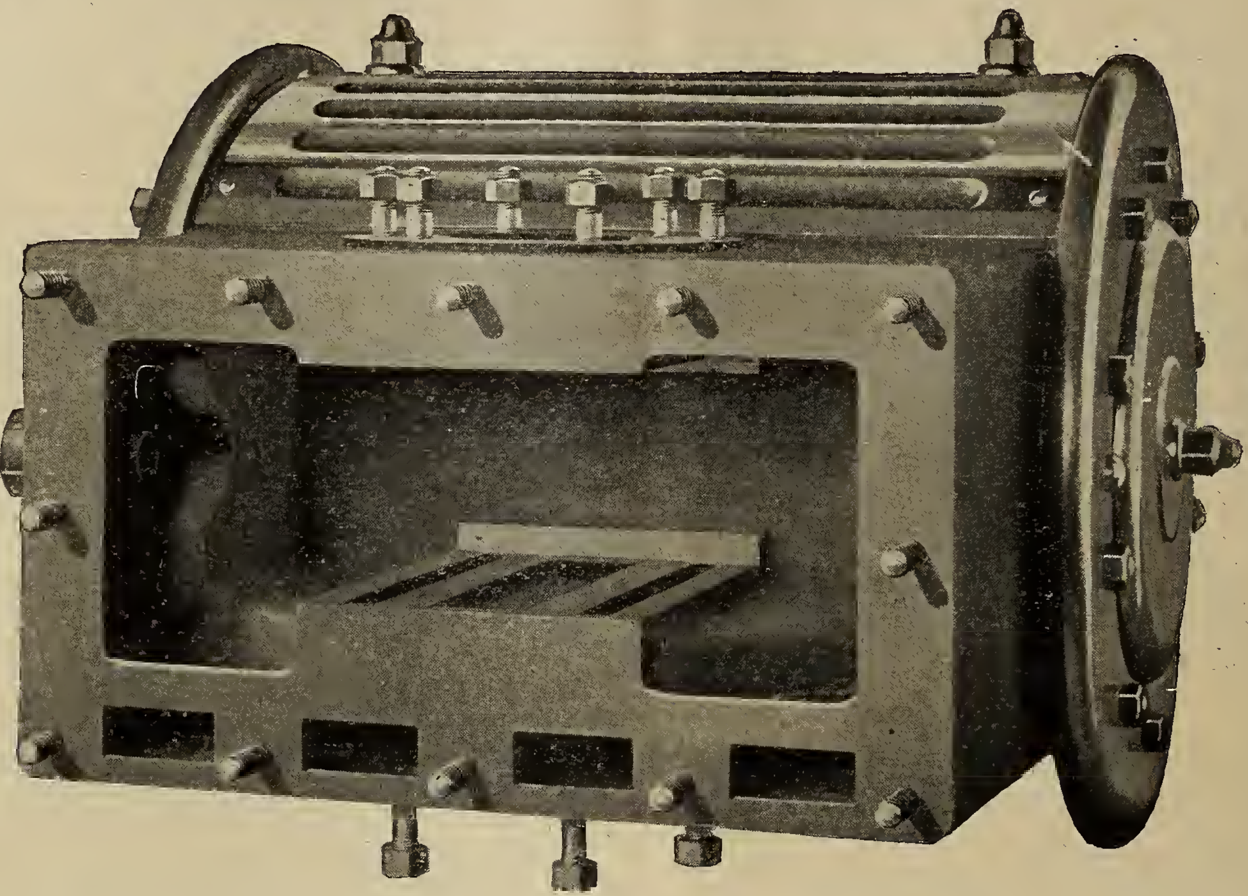
Baltimore, Md.—The Pikesville & Emory Grove Electric Railway and the Falls Road Electric Railway have consolidated, and will enlarge electric power plant of the first-named road, located at Owing's Mills, near Baltimore.

Holly Springs, Miss.—An electric light plant will be established, and Walter G. Kirkpatrick, of Nashville, Tenn., will prepare plans for same.

Langdon, N. D.—Paul Gardner has been granted a five-year franchise to construct an electric light plant.

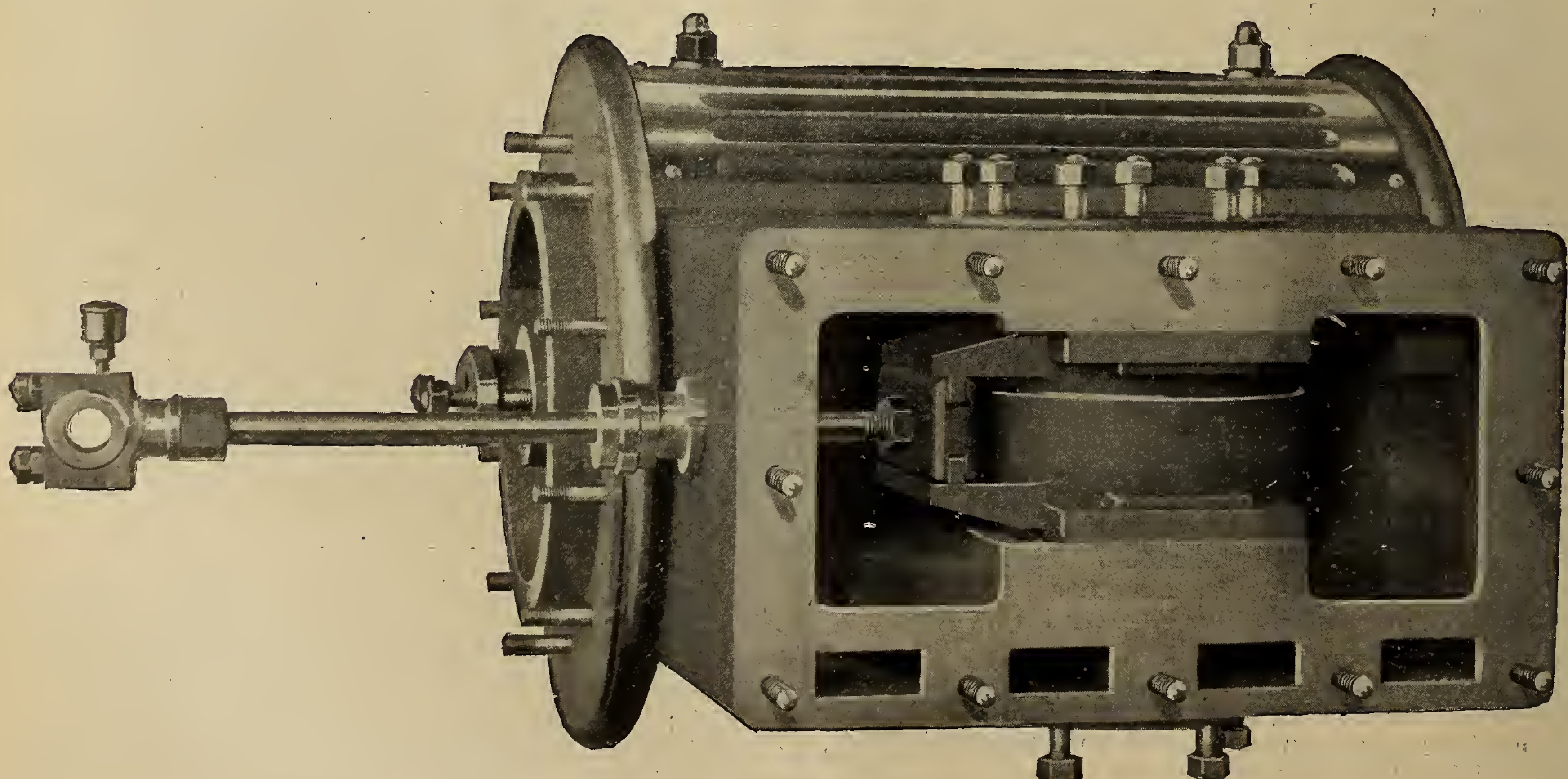
FAMOUS ENGINES FOR ELECTRIC LIGHTING.

The American Engine Company of Bound Brook, N. J., are busily engaged in the construction of the American Ball Engine of the simple tandem and cross compound types.



Steam Chest Without Valve.

This corporation, which has earned a name for itself in the field of mechanical applications and electricity, have improved and completed the present type of American Ball Engine so that it stands alone as a striking example of mehanical excellence, embodying within itself characteristics that place it foremost among the most prominent types.



Steam Chest Showing Valve.

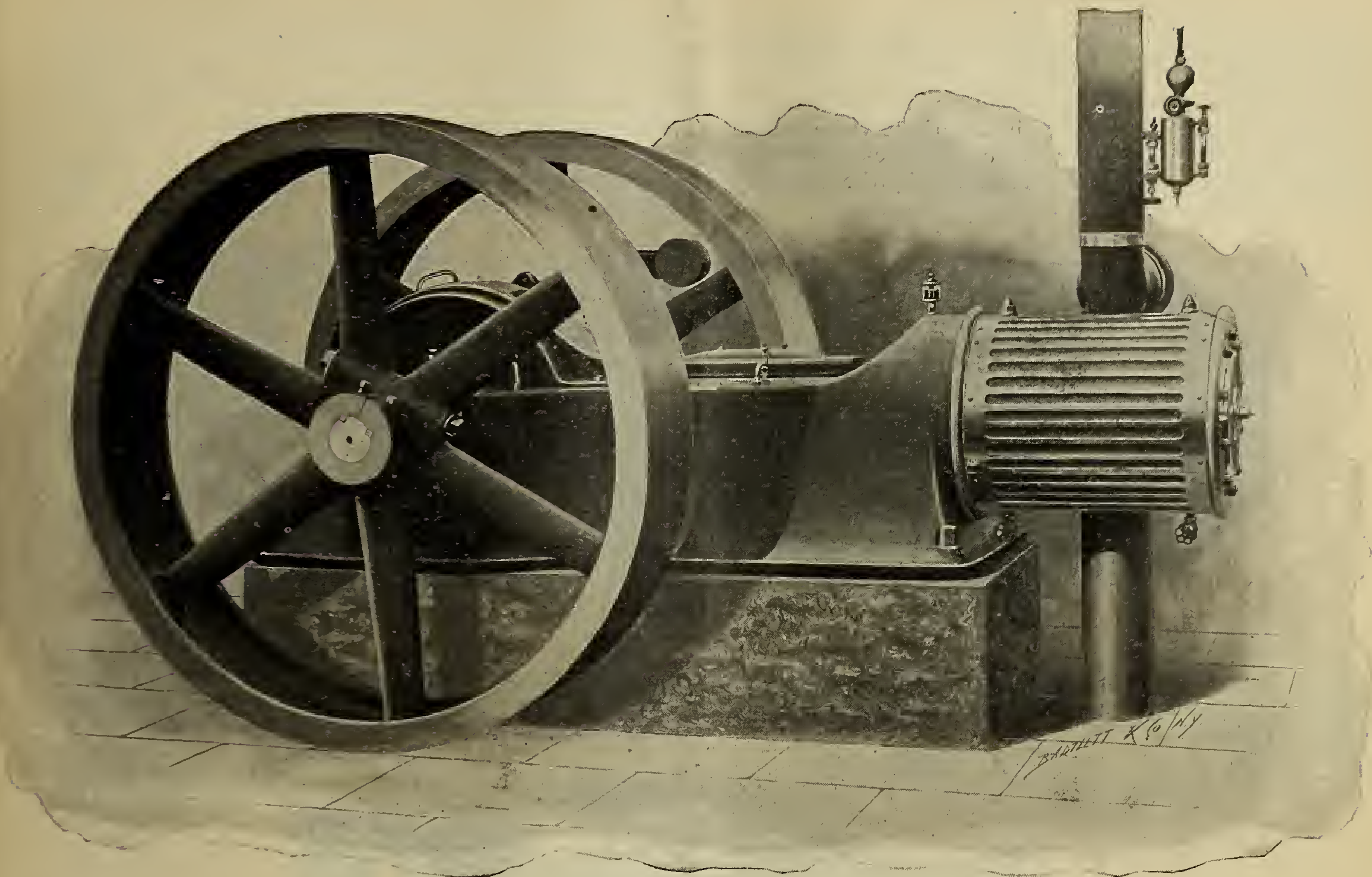
Mr. Frank H. Ball has achieved an enviable reputation in this field of work, and his engines and methods of regulation have been associated with the rise and development of electric lighting in the United States. To such an extent is this true that it may be said that a retardation of years would have been experienced had not impetus been given to this particularly unique branch of work by Mr. Ball.

The American Ball engine is distinctly separate from all past designs with which Mr. Ball's name is associated, and in these few lines we hope to give the more important details some attention.

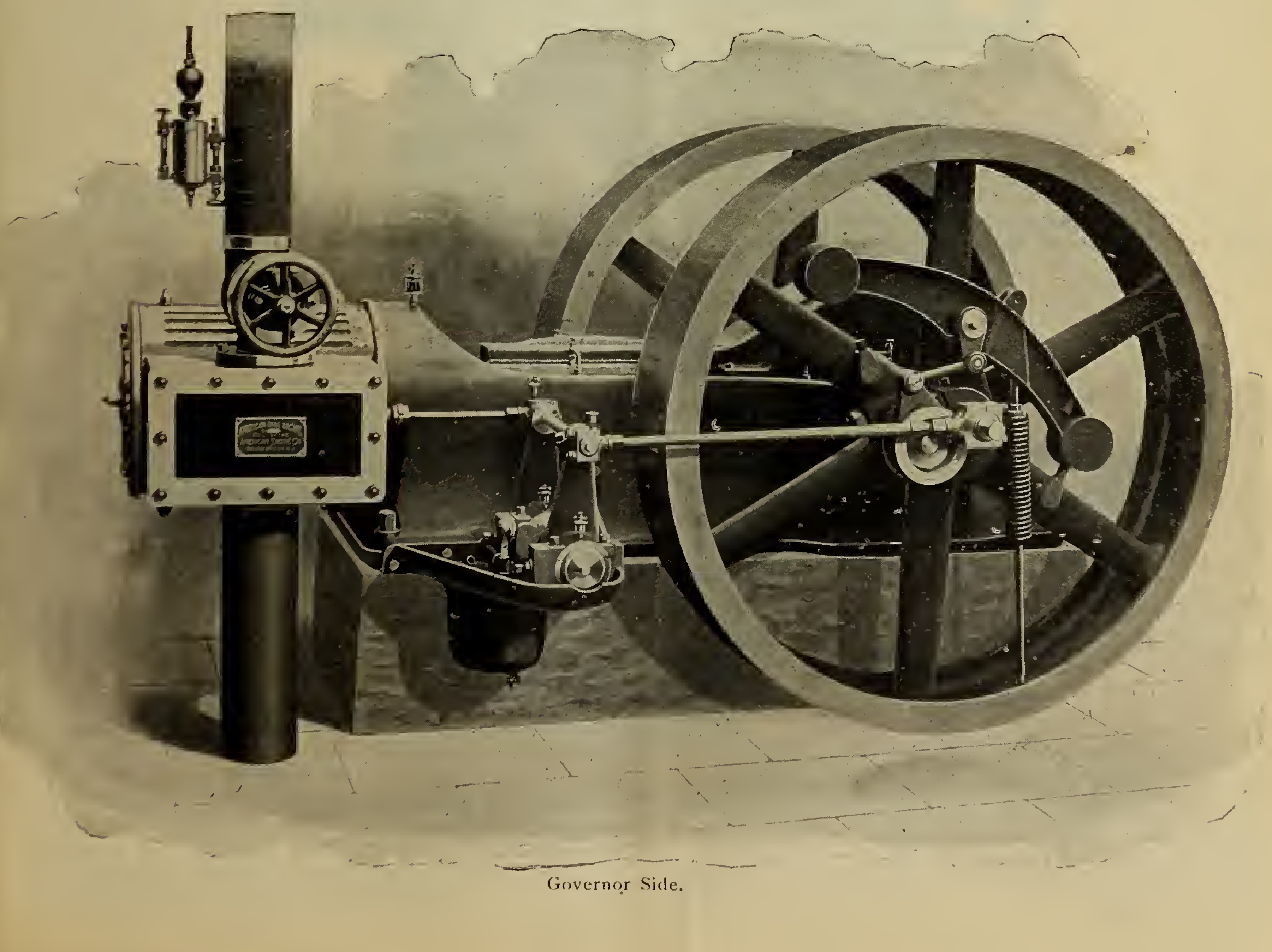
The first two views refer to the standard, simple engine of familiar design. Their staying power has enabled them to resist all the innovations of the period and thus supply all the evidence required to prove their value and vitality from a practical and mechanical standpoint.

The valve in place in the steam chest and the steam chest empty is shown in further illustrations.

The appearance of the valve itself from two points of view will enable the readers to judge of the value and excellence of this engine for electric lighting. The valve shown is employed in at least four thousand engines today. It consists in two parts, being really two valves with backs connected by telescopic sleeves. A continu-



Side View.



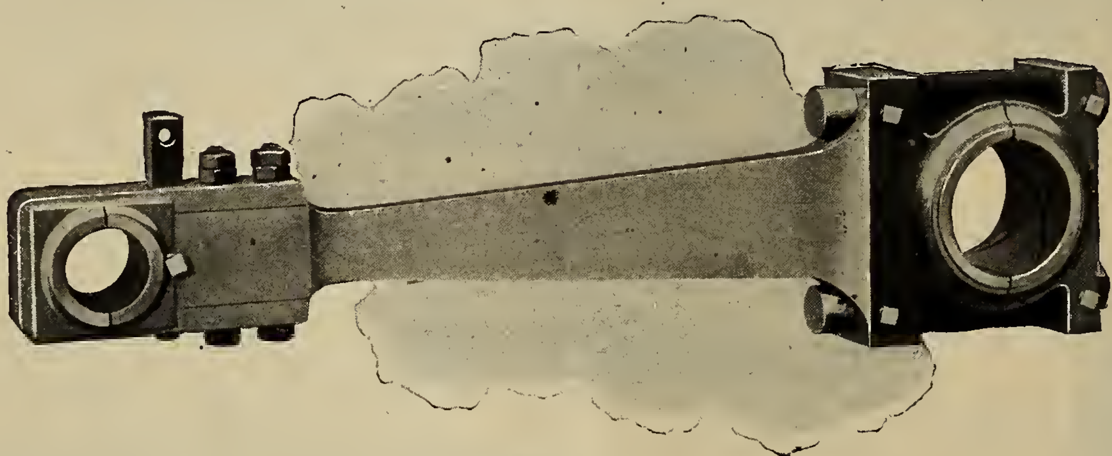
Governor Side.

ous passage is thus formed. In this double valve the two faces perform similar functions with respect to oppositely situated seats in the steam chest.

The steam entering the central opening on the top of the steam chest passes into the inside of the valve. Each face of the valve is kept in place on their seats by steam pressure, which pressure is determined by the diameter of the telescopic sleeve.

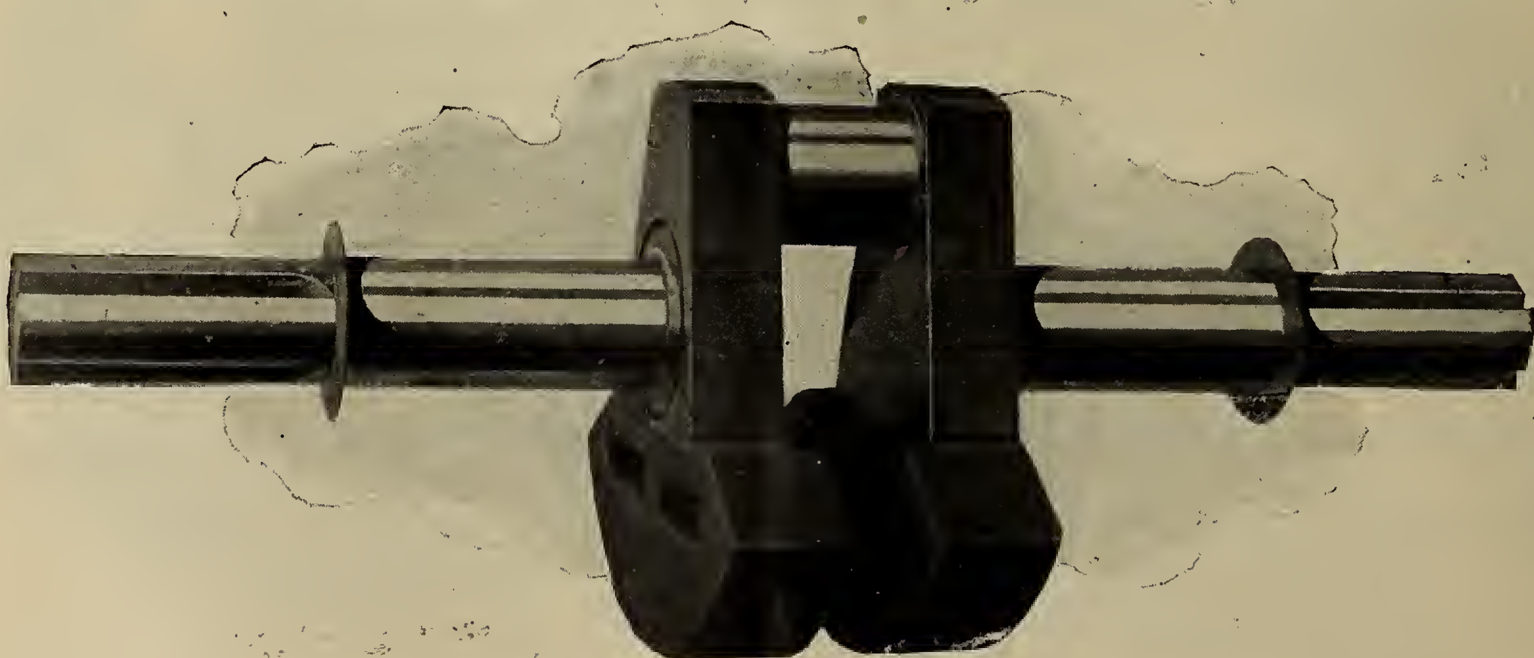
Side View of Valve.

There is none of the friction of unbalanced valves experienced and no leakage, and its durability for a long period unquestioned.



Connecting Rod.

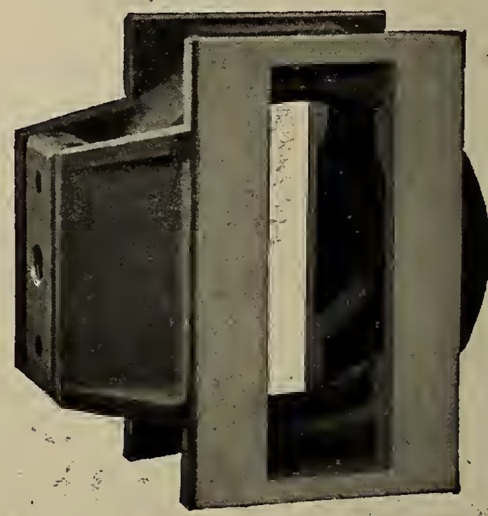
The conecting rod is made of forged steel with the regular strap and pay connection at the cross-head extremity. The nuts and bolts held by means of set screws



Crank Shaft.

are independent, thus making the rod easy to manipulate, the outer half of the box being movable without interfering with the rod anywhere else. Movable liners of babbitt and a crank end of the marine type complete the brief description of the rod which the reader will understand the general gist of. The crank shaft and cross-head are good samples of workmanship and illustrate the detailed attention and finish each part of this machine receives during the process of construction. The officers of this company are R. V. Pierce, president; Frank H. Ball, vice-president and general manager, and U. G. Tingley, secretary and treasurer.

Married—Wednesday, June 2, at 5:30 P. M., Mr. and Mrs. Sigmund Bergman's eldest daughter, Miss Louise



Plan View of Valve.

Helen Bergman, to Mr. Joseph Pschorr of Munich, Germany. The engagement was announced last autumn. The wedding took place at the home of the bride, 725 St. Nicholas avenue, New York. Mr. Pschorr is an officer in the German army, 1st Cavalry of Bavaria, and is attended here by his brother, Dr. Robert Pschorr of Berlin. Among the guests at the wedding were Mr. E. H. Johnson, President of the Interior Conduit Co.; Mr. Samuel Insull of Chicago Edison Illuminating Co. and many prominent electrical people. Mr. Bergman is President of the Electric Equipment Co. of New York, and the Incandescent Arc-Light Co., the largest manufacturers of low-tension arc lamps in this country. Mr. Bergman is

just recovering from a severe shock and injury to his knee received three weeks ago by a fall from his horse.

On and after March 24, 1897, the business of The M. & M. Electric Co., manufacturers of electric sand, batteries, battery and fan motors, will be carried on by the Imperial Electric Co. as their successors.

The high standard of workmanship, as established by them, will be maintained and improved upon if found necessary.

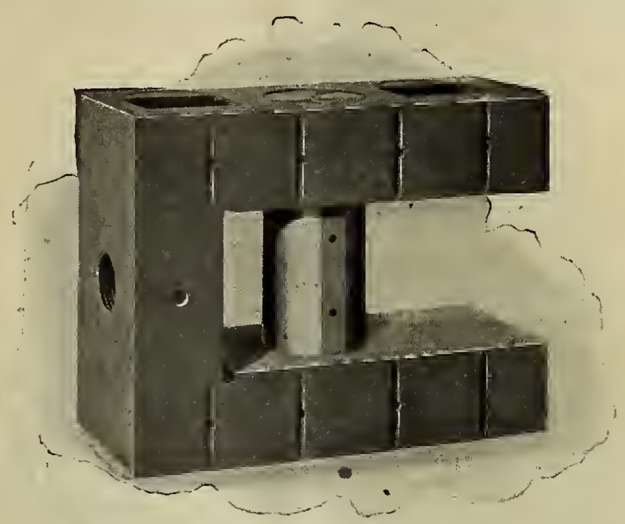
They are manufacturing a very slow speed, direct current motor and dynamo, descriptive circular of which will be sent upon application.

They also contract for manufacturing mechanical or electrical articles in large quantities.

They trust to being favored with your patronage, and thank you for past favors. Very truly yours,

The Imperial Electric Co.

THE PEERLESS RUBBER MANUFACTURING CO., 16 Warren street, New York, have come out with a new stock of their chief specialties: Rainbow, Honest John and Peerless Packings, as well as Eclipse gas jets. The Eclipse has no waste; all pieces. no matter how small, can be formed on the metal tubes into a sectional gas jet. Mr. John H. Deming, the general superintendent, commonly called the Rainbow King, is the inventor and only man that knows how to make it.

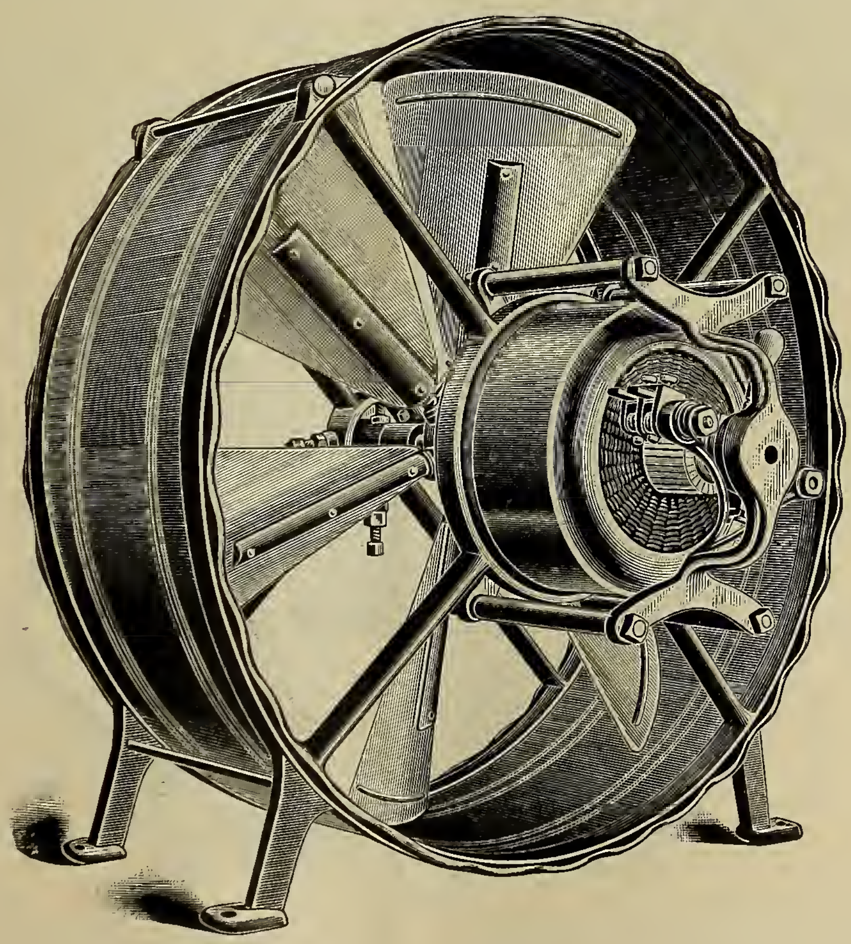


Cross Head (See Page 396.)

THE WING DISC FAN.

The hot weather is gathering its forces together for an onslaught upon this unfortunate town. When the hot wave arrives woe betide the restaurant without fans or the basement minus a ventilator.

It will not only be a matter of keeping cool but of keeping customers from going to hated rivals in trade, all because the ventilators and fans had not been ordered in time. L. J. Wing & Co., 109 Liberty street, New York, can remove these sad prospects by an array of famous disk fans and ventilators. In addition they manufacture marine gas engines for yachts, launches and business boats and motors for horseless carriages.



The Wing Disc Fan.

WHITE & MIDDLETON are in the field selling lots of gas and gasoline engines for all power purposes including electric lighting. Their address is 107 Liberty street, New York City.

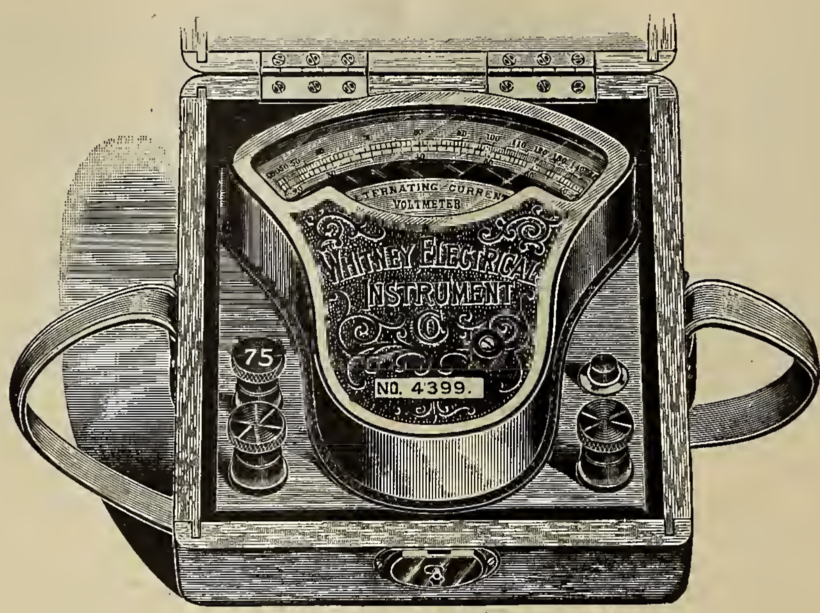
Camden, S. C.—S. Logan Lang desires estimates and proposals on electrical machinery to convert 15,000 horsepower into electricity and convey it five miles.

Siloam Springs, Ark.—W. H. Daney, secretary, may be addressed concerning construction of electric light plant.

A NEW LINE OF AMMETERS AND VOLTMETERS.

Appreciating the demand for a reliable, but low-priced, line of testing ammeters and voltmeters for both direct and alternating current the Whitney Electrical Instrument Company, of Penacook, N. H., have brought out a modified form of their well-known Hoyt type. While it is not by any means their intention to discontinue the manufacture of the latter instruments, it has been found that although by far the most accurate method of taking measurements, instruments operated on the dynamometer principle are not as convenient for rapid testing as are the indicating type; hence the new instruments are in this form and are constructed with especial reference to making them convenient when used as portable instruments. They are mounted upon handsomely finished mahogany bases and covered with neat dust-proof cases of aluminum while a strong, well-made, hard-wood case with lock and key, accompanies each instrument. This case is designed so that the instrument can be used without removing from the case, although it can be removed when it is desired to use the instrument for laboratory work. Both the ammeters and voltmeters will read correctly on alternating current of any frequency as well as on direct-current circuits, and there is no appreciable heating error.

The ammeters are made in a variety of ranges from one ampere up to one thousand, and the voltmeters up to 10,000 volts, both in single and double scale. These instruments are tested to stand 2,000 volts between the terminals and cap, thus eliminating all danger in the case of grounds on the line. Although the instruments are very compact, occupying a space of only 6×6, they have a scale length of nearly five inches, giving very open deflections.



Whitney Voltmeter.

Whitney Ammeter.

MAGNOLIA METAL COMPANY.

The following notice from the Magnolia Metal Co. will be of interest to our readers:

We beg to inform you that the firm of Sugden, Pound & Wagner of London (former selling agents for Magnolia Metal in Europe and who traded under the name of the Magnolia Anti-Friction Metal Co., Great Britain, by special permission of our Company) have been dispossessed of their agency by the English Courts and that our London office and our foreign business are now under the management of Mr. Charles B. Miller, the president of this company.

We beg also to inform you that Messrs. Sugden, Pound & Wagner were recently perpetually enjoined, together with the Atlas Metal Co., Limited, of London, John Sugden, Max Wagner, Arthur George Brown, The Globe Engineering Co., Ltd., of Manchester, Atlas Bronze Co., Limited, and the Atlas Bronze Co., from continuing the fraudulent business of making an anti-friction metal and branding it with the trade-mark of the Magnolia Metal Co. of New York, imitating their ingots, marking the boxes in which the metal is packed "Made in the United States," and otherwise deceiving and imposing upon purchasers of anti-friction metal in Great Britain and Europe.

Justice Collins heard this case and gave judgment against Sugden, Wagner, Brown, The Globe Engineering Co, Ltd., and others for selling counterfeit goods and deceiving the public by representing the goods they sold

were made in the United States by the Magnolia Metal Company.

An appeal was taken from the injunction above referred to. This appeal was tried before the Court of Appeals, Lord Esher presiding, and the perpetual injunction granted by Justice Collins was confirmed. It was in this trial that Lord Esher denounced the action of the parties above named and characterized their performance as "A Disgusting Fraud."

It has come to our notice that parties in this country have attempted to perpetrate a similar fraud, and we now have one Western firm in the courts over this matter, and we desire through your columns to warn the engineers and the general public, users of anti-friction metal, against these fraudulent attempts to pirate and appropriate the use of our trade-marks and name of our metal.

Every bar of Magnolia Metal bears the steel stamp of the Magnolia flower and the impression of the steel die "Patented June 3rd, 1890" and "Manufactured in the United States," with the exception of the metal manufactured by this Company in Russia, which bears the stamp of the Magnolia flower and the words, "Manufactured in Russia."

The president is Chas. Miller; vice-president, E. C. Miller.

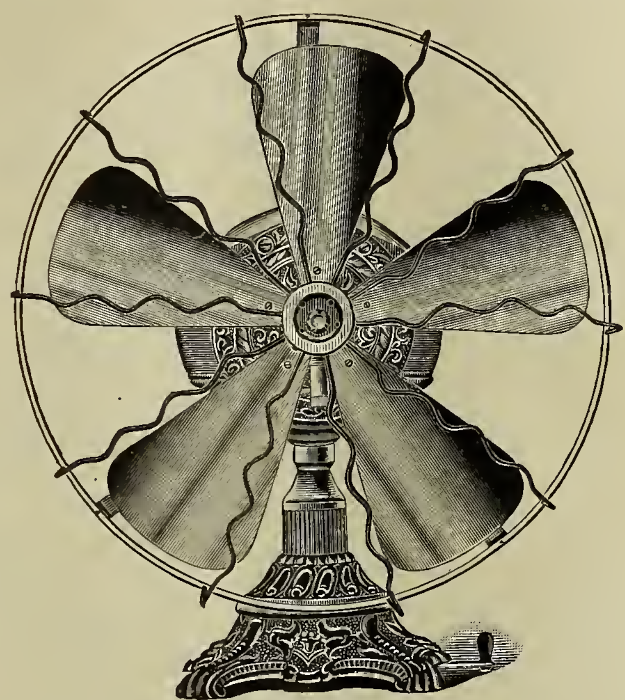
Magnolia Metal Co.,
266 & 267 West street,
New York.

Martin, Tenn.—City Clerk may be addressed concerning establishment of electric light plant.

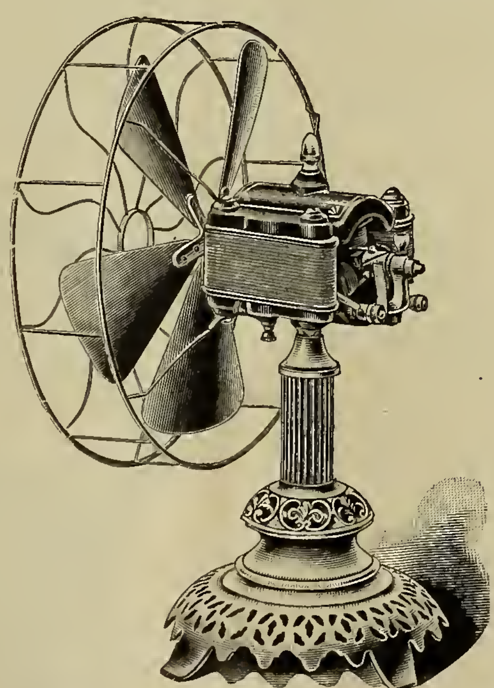
IMPERIAL ELECTRIC CO.

The following illustrations refer to types of machines manufactured by the Imperial Electric Co., 140 Washington street, New York City.

The 110-volt direct-current fan manufactured by this concern is warranted from every standpoint either electrical or mechanical. It is beautifully finished and is supplied with a brass fan and guard running smoothly and noiselessly. Its efficiency is very high and the complete absence of sparking is an indication of the best design. These fans are made of two speeds and sizes; the 14-inch fan, 1,700 revolutions and 1,400 revolutions; the 12-inch fan running at 1,800 and 2,000 revolutions per minute.



Imperial Electric Co.'s 110-Volt Fan Motor.



Imperial Electric Co.'s Battery Motor.

The new pedestal fan motor forms part of an outfit consisting of a battery equipment complete in a polished oak case and supplies for the same.

The motor as illustrated is wound for six volts and is called type K. It is supplied with a seven or ten-inch polished brass guard, double connecting cords and a substantial base very prettily ornamented. One charge of the batteries will run the pedestal motor about 50 hours; it may be used for the operation of a phonograph, etc., for fifteen hours, if the batteries are used occasionally and allowed to recuperate. For a strong breeze this outfit can compete with the best on the market.

Valley City, N. D.—City Clerk may be addressed concerning establishment of municipal electric lighting plant.

AT THE N. E. L. A. CONVENTION.

The Interior Conduit and Insulation Company of New York, while they did not have a whirl of motors at the convention, Mr. D. C. Durland, their representative, kept the air moving with his presence about the rotunda of headquarters. The rotunda of the International Hotel was a busy mart every day of the convention, so that Mr. Durland only had to mention "Lundell Motors" when this popular standard was at once recognized. A number spoke of the absence of Lundell goods and remarked that they were so well known they needed no exhibition. Lundell goods are sold up to the capacity of the works.

GEORGE R. LEAN, superintendent, Jandus Electric Co., of Cleveland, Ohio, represents Buckeye Electric Co., of Cleveland, Ohio, with a complete line of incandescent lamps.

The H. W. Johns Mfg. Co. had an exhibit of a number of samples of moulded mica and Vulcabeston material for insulating electrical apparatus, also their new Giant arc lamp hanger and insulator, Toggle clamp insulator for field cables, H. W. J. street car heaters and the Electrothorn heating pad, in which the temperature can be kept constant by manipulating the regulating switch, and the automatic operation of the thermostat situated within the pad to prevent the pad from exceeding a given temperature, was fully explained by Mr. W. F. D. Crane, who represented the company at the convention.

MONARCH INSULATING PAINT, manufactured exclusively by the Bradford Belting Co., of Cincinnati, Ohio, was represented by Mr. E. P. Morris, of No. 15 Cortlandt street, New York. The many uses of this famous paint are well known to the trade.

THE NOWOTNY ELECTRIC CO., of Cincinnati, Ohio, was represented by Mr. E. P. Morris, of No. 15 Cortlandt street, New York. Some of their celebrated long-burning inclosed arc lamps were on hand for inspection by the N. E. L. A. delegates.

MR. FOSTER M. VOORHEES, of Elizabeth, N. J., the receiver for a large electric company, was present at the N. E. L. A. He is the duplicate of Barringer Cox, the thermo-generator man.

Members and guests not mentioned in last issue :

Edgar, H. T., New York.
Jenning, J. J., Wilks Electric Co., Wilks, Pa.
Humphrey, C. B., Heine Boiler, Pittsburgh, Pa.
Phillips, E. F., Mutual Elec. Co., Detroit.
Allen, E. H., Beacon L. & P. Co., Chicago, O.
Estabrook, C. E., G. E. Co., New York.
Newell, D. E., Para. Phem. Pulley, New York.
Burns, C. V., Rochester, N. Y.
Peoples, G. L., S. G. Flagg Co., Philadelphia, Pa.
Foster, R. C., Cleveland, O.
Brady, T. H., Mast Arms, New Britain, Conn.
Levine, J. P., Acetylene Gas, Newfoundland.
Latt, J. C., Fort Wayne Electric Company, New York.
Dee, A. V., Philadelphia, Pa.
Wetzler. Mr. and Mrs. Jas., (E. E.) New York.
McKinlock, G. A., Chicago, Illinois.
Hale, R. S., Boston, Massachusetts.
Smaill, A. E., Montreal.
Webster, N. D., American Electrician, New York.
Noecker. F. M., Edison Co., Renova, O.
Murphy, J., Edison Co., Renova, O.
Armstrong, F. C., Can. Gen. Elec. Co., Toronto.
Le Blond, F., N. F. Elec. L. & P. Co..
Johnston, W. J., Electric World, N. Y.
Johnston, Mrs. W. J., New York.
Johnston, F. A., New York.
Scheeffer, Louis, Antwerp, Belgium.
Lloyd, H., Elec. Stor. Battery Co., Phila.
Child, C. T., Elec. World, N. Y.
McRoy, J. T., Chicago.
Ross, C. A., Sawyer-Man Co., Chicago.
Law, W. W., Elec. Appl. Co.
Hunt, W. T., Electrical Age, N. Y.

NEW TELEPHONE COMPANIES.

Wesson, Miss.—The Wesson Mill & Improvement Co. contemplate the erection of an electric light plant. They desire estimates on same.

Eastman, Ga.—The Eastman Electric Light & Telephone Co.: W. N. Leitch, F. B. Stubbs, J. B. Caldwell and others, have obtained a franchise for lighting and contracted for erection of plant.

Taunton, Mass.—The Providence and Taunton Electric Railway Co. directors have petitioned for a franchise for road through towns of Seekonk, Rehoboth and Dighton.

Nevada, Mo.—H. C. Moore has been granted franchise for electric lighting.

POSSIBLE CONTRACTS.

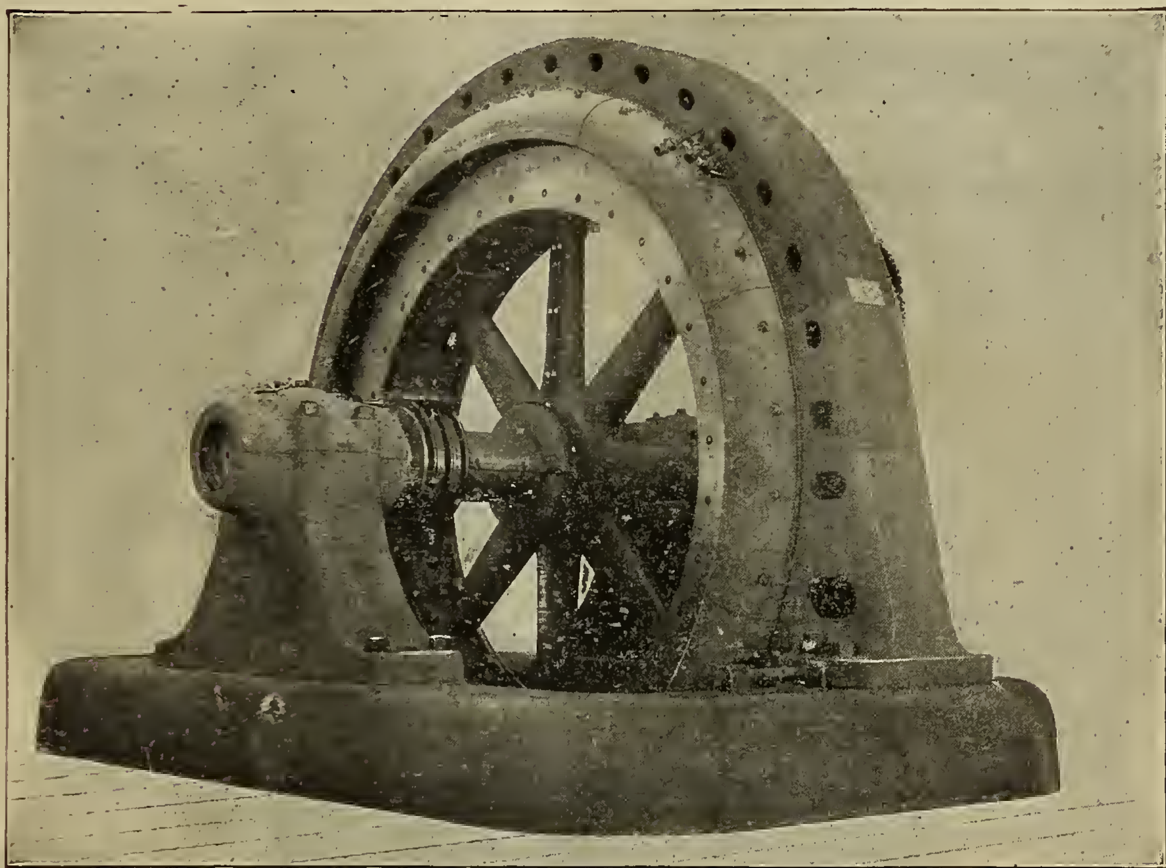
Kings Mountain, N. C.—The Dilling Cotton Mills will put in a 500-horse power engine.

Denver Colo.—City Clerk may be addressed concerning construction of new electric light plant.

Glasgow, Ky.—Glasgow's electric light plant has been totally destroyed by fire at a loss of $15,000, with $10,000 insurance.

The Electrical Age.

VOL. XIX., No. 26. NEW YORK, JUNE 26, 1897. WHOLE No. 528



A Revolving Field Armature.

REVOLVING FIELD ALTERNATORS.

The development of the revolving field type of alternating current generator and the standardization of a complete line both for the monocyclic and three-phase systems has of late occupied the attention of the engineering department of the Geneial Electric Co. with successful results. The alternators are designed for the standard frequency of sixty cycles and for pressures ranging between 500 and 5,000 volts.

The machines are built on the same lines as the General Electric type of induction motor. The stationary armature is built up of laminations stamped from specially selected and tested steel plates. Ample spaces are left for ventilation and the coils are covered and protected by shields. The base of the armature is of smooth cast iron and the pedestals supporting the bearings are provided with spherical seats which support the boxes and allow of perfect alignment.

The removable bearings are, of course, self oiling with the oilways so cut as to give an even flow of oil from the resting places of the rings in the shaft to the end of the bearings where the oil returns to the reservoir.

The revolving field is extremely simple in construction. It is merely an iron spider mounted on a shaft carrying a soft steel ring serving as a yoke for the pole pieces, which are made up of laminated iron with polar projections. The field coils are removable and in the larger sizes are wound with flat copper strips placed edgewise, to allow of free egress from the coils of any heat. The armature can be moved along the base to facilitate access to fields and armature winding.

With a high efficiency these alternators combine good inherent regulation and can be, if desired, compounded for accurate automatic regulation. Such compounding in certain cases is not necessary to convenient operation, and may be omitted. When compounded a commutator is mounted on the shaft and rectifies current supplied from a series transformer in the main circuit. These compounding devices are not, however, included in the generator properly so called. They come under the head of extras. The temperature of the armature and the field windings does not rise above 45° Cen. above that of the surrounding atmosphere.

The new type of generator is not, of course, intended to displace the revolving armature type. The revolving field type has its own special field of usefulness. It is free from high potential collector rings and commutators, the only collector rings being the two used to bring the exciting current to the revolving fields. The high potential part of the alternator—the armature—being a stationary structure, can be wound and insulated for much higher pressures than is desirable for revolving armatures, and the current can be fed directly into the line without the intermediary of step-up transformers. All the high potential terminals are effectually insulated.

The revolving field alternators can be wound for two-phase system when desired, and when so wound are so arranged that armature coils can be cut in or out to give independent regulation of the two-phase.

During the past year the General Electric Company has built a number of machines of this type; some for belt drive, but principally for direct connection to water wheels and steam engines. The illustration shows a 750-kilowatt, forty-pole, three-phase machine running at 174 revolutions and delivering current at 4,400 volts. It is one of the twelve which will be used on the great Lachine Rapids installation.

REGULATOR FOR DYNAMOS.

The following is a description of a new regulator for constant series arc generators, and it is especially adapted to the large Brush arc generators, Nos. 9, 10, 11. It can, however, be applied to others.

On the Brush arc generators it is placed in the same position as their present regulators, which is now attached to the rheostat, it being only necessary to drill and tap two three-eighth-inch holes into rheostat case to secure it in position. The regulator consists of but a few mechanical parts which are operated by a single electro-magnet of new design, which is connected in series with the lamp circuit and which throws the combination in and out of action.

It has no sparking contacts to become oxidized and inoperative, no wall controller, no shunt coils or circuits, and when it is once adjusted to the desired current it will always remain so, making it unnecessary to interfere with it at any time when starting or stopping the generator, being perfectly controlled by the current generated in the machine. The combined movements of rheostat and brushes are operated with such promptness that an increase or decrease of about one-tenth of an ampere in the circuit will bring the regulator into action.

Figure (1) shows the regulator attached and in working order on one of the large Brush machines, while Figure (2) shows the general arrangement of the regulator in which (1) is the spool and which is wound to have a power sufficient to hold the armature (3) balanced in line with the poles (2), acting, of course, against tension spring (6). In this condition the armature is maintained midway between the stops (5) and the rocking lever (8), which is connected to armature by connecting link (7), is maintained in position which supports the pawls (12 and 13) out of engagement with the ratchet wheels (14 and 14), and the whole is in a state of equilibrium.

If now the current of the dynamo decreases, from increase of load or otherwise, the decreased power of spool will allow the armature (3) to be lifted by tension spring (6), and this will rock the lever (8) and allow the pawl (12) to engage the ratchet wheel (14). (As shown in print).

The constantly oscillating arm (17) will then cause the pawl to move the rachet (12) toward the right and slightly move the brush rocker the opposite way and at the same time rotate the gear which meshes with the rack (16) and this will move the rheostat arm (22) to which the gear (15) and rachet wheels (14 and 14) are all three secured together by screws (not shown).

The rocking lever (8) is pivoted on a stand or support (9), which is vertically adjusted, as by screw "A." On rocking lever (8) are pins (10 and 11), which form seats for the pawls as they slide to and fro. When lever (8) is tilted, supporting pin departs from pawl, which engages the ratchet wheel (14). On the other hand it will be noted that supporting pin lifts opposite acting pawl further away from its ratchet. Thus it is impossible for both of the pawls to engage the ratchets at the same time. (18) is a table cast rigidly to the oscillating arm and upon which the pawls are mounted. (21 and 23) pertain to rheostat. A small belt driven by the armature shaft of generator runs the pulley wheel (19), which has a rigid eccentric (24) giving a constantly oscillating motion to the oscillating arm (17), to which the pawls are attached. (20) is a rigid shaft on which rachets 14 and 14, gear (15) and rheostat arm (22) are all secured, revolving together by the operation of the pawls. (25) is a bracket fastened to rheostat supporting the mechanical parts of regulator, but broken away to show parts, while the bracket (26) supports the electro-magnet.

Balancing screw (4) performs but one duty, that is, to adjust the armature (3) to a vibrating balance. Of course this is to be done when spool is not energized by current and with tension spring (6) unhooked, but all the other parts in place. After vibration of armature is obtained,

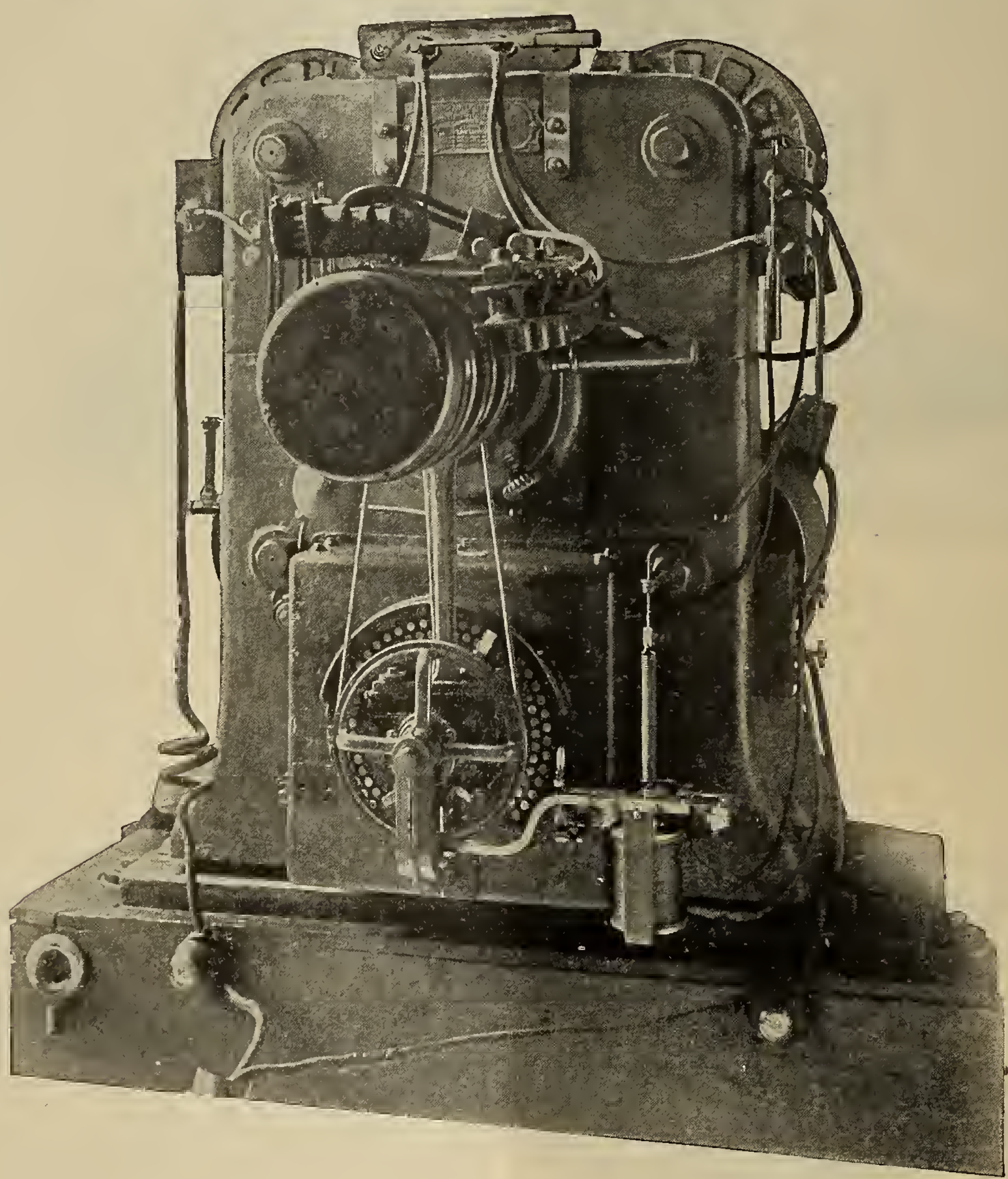


Fig. 1.

the wheel (19) is given a few revolutions by hand to ascertain that neither of the pawls engage the ratchets. Should they engage the ratchets, perhaps they are adjusted too close. If found to be in their right position, tension spring (6) is hooked in and adjustment is obtained by threading up on nut (27), which increases strength of current, while the slackening of tension will reduce the strength of current, this being the only adjustment for increasing or decreasing current. The limit of motion to each of the ratchet wheels is obtained by the omission of one of the teeth on each wheel, the reciprocating pawl traveling between the increased space thus formed as at 28. Latch (D) is adjusted by screw (E), which sets the armature (3) so that neither of the pawls will engage their ratchets, giving free command of the brush rocker by hand until the required strength of current is reached, when the latch automatically releases itself, placing the regulator in operation. The only change which is necessary to place the regulator on a left hand machine is the connecting of armature (3) to the opposite side of rocking lever (8).

The application of this regulator for constant potential

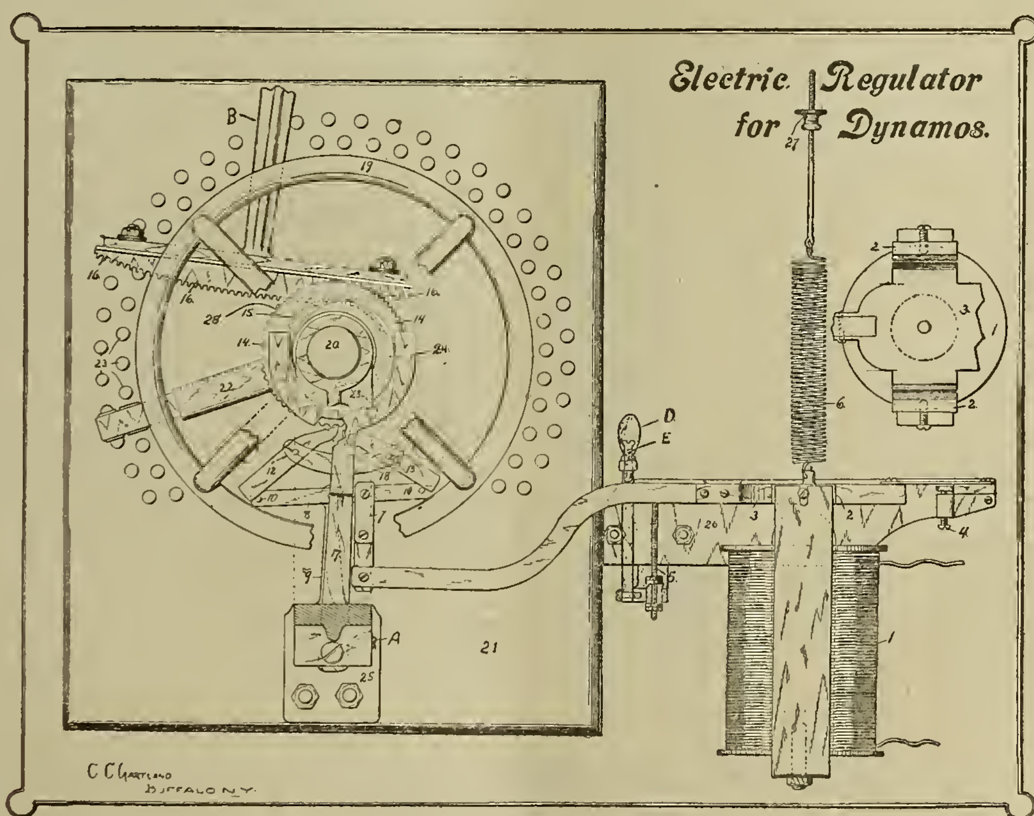


Fig. 2.

is in the same manner, the spool (1) being wound according to the E. M. F. required. It may also be applied to the regulation of alternating current machines as well as to separately excited machines generally, by connecting the rheostat in series with the field coils of the exciting machine, and in the case of the alternating machine, preferably connecting the spool (1) in the secondary circuit from a transformer in which circuit a second rheostat operated by a spool in the primary circuit of the alternator is also interposed; said second resistance being so arranged as to give to the spool (1) the same amount of current (and hence of strength) with 110 volts potential around it as at 100 volts, thus automatically taking care of the line loss on primary circuit in exact proportion to the loss, at any and all variations of load. When used to regulate the speed of machinery, the arm (B) is connected to any suitable speed governor, and electric current is supplied to the spool (1) from any convenient source.

A SUB-SEA TERROR.

Elizabeth, N. J., May 17.—The Holland submarine torpedo boat was launched at the Crescent Shipyards in this city at 8:45 this morning.

The inventor of the boat is John P. Holland. He had been at the yards closely watching the construction of the vessel. The vessel was christened The Holland by Mrs. Nixon, wife of Lieut. Lewis Nixon, the constructor. There were but few present at the launching.

Inventor Holland says there will not be any attempt at submarine evolutions for several weeks.

The construction of the boat has been eagerly watched all over the country. The boat is cylindrical in shape, is fifty feet three inches long, with a four-foot screw-protecting extension. The diameter is ten feet three inches amidships and the moulded diameter is the same.

The boat can travel under water eight knots an hour for eight hours and ten knots on the surface.

The power comes from a gasolene engine and a dynamo, the former to be used when the boat is sailing along the surface and the latter when she is submerged.

It will take less than a minute to submerge the boat and about the same length of time for her to rise to the surface.

The armament consists of three torpedo tubes, one at the upper bow of the boat being an aerial torpedo thrower, with a range of one mile.

Six projectiles weighing 180 pounds each, with charges of 100 pounds of explosives, are to be stored for this gun.

There is an expulsion tube for Whitehead torpedoes almost directly beneath the torpedo thrower. But three of these will be carried, as each weighs 850 pounds.

There is a submarine gun at the stern of the boat which, with a 100-pound charge of explosive, can hurl a 400-pound projectile one hundred yards through the water. Five of these will be carried.

Six men will constitute the crew. As soon as she was launched the boat was boarded by a force of engineers to make any alterations necessary.

Mr. Holland was asked by the United States, English and Spanish governments to allow a representative on board during the trial trip of the boat, but he refused the request.

After a trial trip, he says, he will allow an engineer from each government to see the workings of the boat, which it is believed will revolutionize warfare.

Several foreign nations have bid for the vessel, but it is likely that Mr. Holland will sell her to the United States, because this government has approved of the patents for the boat.—*N. Y. World.*

Grand Marais, Mich.—An electric light plant will be established.

THE SYNCHRONOGRAPH.

A New Method of Rapidly Transmitting Intelligence by the Alternating Current.

By Albert Cushing Crehore, Ph.D., Assistant Professor of Physics, Dartmouth College, and George Owen Squier, Ph.D., First Lieutenant of Artillery, United States Army, Instructor Department of Electricity and Mines, U. S. Artillery School.

(Continued from page 386.)

The same message was then received in two lines, and one line gave the complete message as before, while in the other line there appeared a record for each complete unit in which the current was made. The papers of either the first or the second half of each complete cycle composing the message upon the wheel were next removed, and the message received in two lines as before. The result showed the message complete in one line, while in the other line appeared an uninterrupted succession of marks just as given by the simple alternating current received in one line.

Fig. 14, referred to in last week's article, is reproduced in this issue.

If then an uninterrupted line of marks can be received in one line at the same time that a message is being received in the other, this uninterrupted line can be used for a second message entirely independent of the first. The next experiment accomplished this, and it is now possible to use the same line to send two entirely independent messages in the same direction at the same time at a high rate of speed. The preparation of the transmitting tape to accomplish this, simply requires that the two messages, each prepared with a double unit, shall be displaced a semi-cycle with respect to each other as they pass through the transmitter.

The advantages of duplexing the line, that is, sending two independent messages in opposite directions over one wire at the same time seem more important than those of diplexing the line. An arrangement of circuits which accomplishes this proves to be very simple. Moreover it permits entirely different frequencies to be employed by the transmitters at the two ends of the line, and as before involves no synchronous receiver at either end. By duplexing the line the speed of transmission over a single wire is practically doubled; for example, a line that carries 3,000 words simplex can carry 6,000 words per minute duplex.

It is desirable in many cases to manifold the original copies of the message received, and experiments were made to accomplish this. All that is necessary is to attach to one terminal, instead of a single needle, as many needles as the number of copies desired, having each make its record upon a sensitive surface. The manifolding process evidently applies to either simplex or duplex receiving. Manifold copies of messages may be received in widely different localities at the same time from one and the same transmitter, by connecting the receivers in series or in parallel.

The alternating current is adapted to use with condensers in series with the line where a direct current cannot ordinarily be employed. An experiment was carried out to send a message through a condenser having a capacity of 9.57 microfarads in series with the line, and it was found that the message was transmitted correctly. One object of this experiment was to establish the possibility of using a set of Morse instruments upon the line at the same time that the messages were being transmitted at a high rate of speed by the alternating current. By shunting condensers around the set of Morse instruments it was found that the operation of either system did not affect the working of the other, so that it becomes possible to use the same high speed line for a complete system of quadruplex telegraphy at the same time. Indeed it seems possible that the present Wheatstone system could be operated over the line in conjunction with the alternating-current messages. The experiments with the chemical tape which have been outlined above, together with others not here given, demonstrate the flexibility of a system of intelligence transmission employing the alternating current.

The use of the alternating current as a means of sending intelligence in connection with the fact that a message can be sent through condensers, suggests the possibility of using the principles of electrical resonance employing circuits having natural periods of their own which will pick out and respond to currents from the line having their own frequency.

Although the above illustrations have employed for the most part the Continental code representing a dot and a dash in a particular manner by the omission of certain waves, and the spaces between letters and words by the presence of waves, yet it is evident that this is but one of many combinations which this system permits, and that mentioned above is not to be understood as representing the most desirable one.

A characteristic of the records made by electrolysis is the natural separation of the positive and negative waves of current, which is an advantage in interpretration. This separation is also accomplished in the polarizing receiver by employing two receiver tubes. Instead of setting the polarizer and analyzer for extinction they are so placed that some light is normally transmitted through each tube. The tube coils are so connected that a positive current produces approximate extinction in one tube, and a maximum transmission of light through the other. A negative current transmits a maximum of light through the first tube, and produces approximate extinction in the second. An alternating current therefore causes a record of the positive waves through one tube, and the negative waves through the other, and thus accomplishes all in this respect that the chemical receiver does.

The Line.

It is generally understood that the line limits the speed of telegraphy. The limit is usually reached because of the distributed electrostatic capacity of the line rather than its resistance. The influence of the distributed capacity is to change the form of the wave as well as reduce its amplitude. With a given length of line having a certain static capacity, there exists limits to the speed obtainable with any given set of instruments which would be a difficult mathematical problem to predetermine. The difficulty in making this calculation is in the influence exerted by the particular instruments used. With different instruments the upper limit of speed is very different with the same line. It therefore seems that the only way to determine this question is by submitting the system to actual trial over a long line.

In order to test this system over as long a line as was available, the land telegraph and telephone lines upon the military reservation at Fort Monroe were joined in series making about thirteen miles of iron wire having a resistance of 320 ohms. Not only was no difficulty experienced in transmitting and receiving messages over this line, but resistance was introduced making about 1,500 ohms total including the polarizing receiver coil of 390 ohms. This trial was at a frequency of about 200 complete periods per second. With the chemical receiver a coil of 10,900 ohms was used in the laboratory and the record was plainly received at a frequency of about 545 complete periods per second.

Since the polarizing receiver gave indications showing the approximate strength of the varying currents by the intensity of the light upon the plate, it was used to study the effects upon the currents of arbitrarily introducing

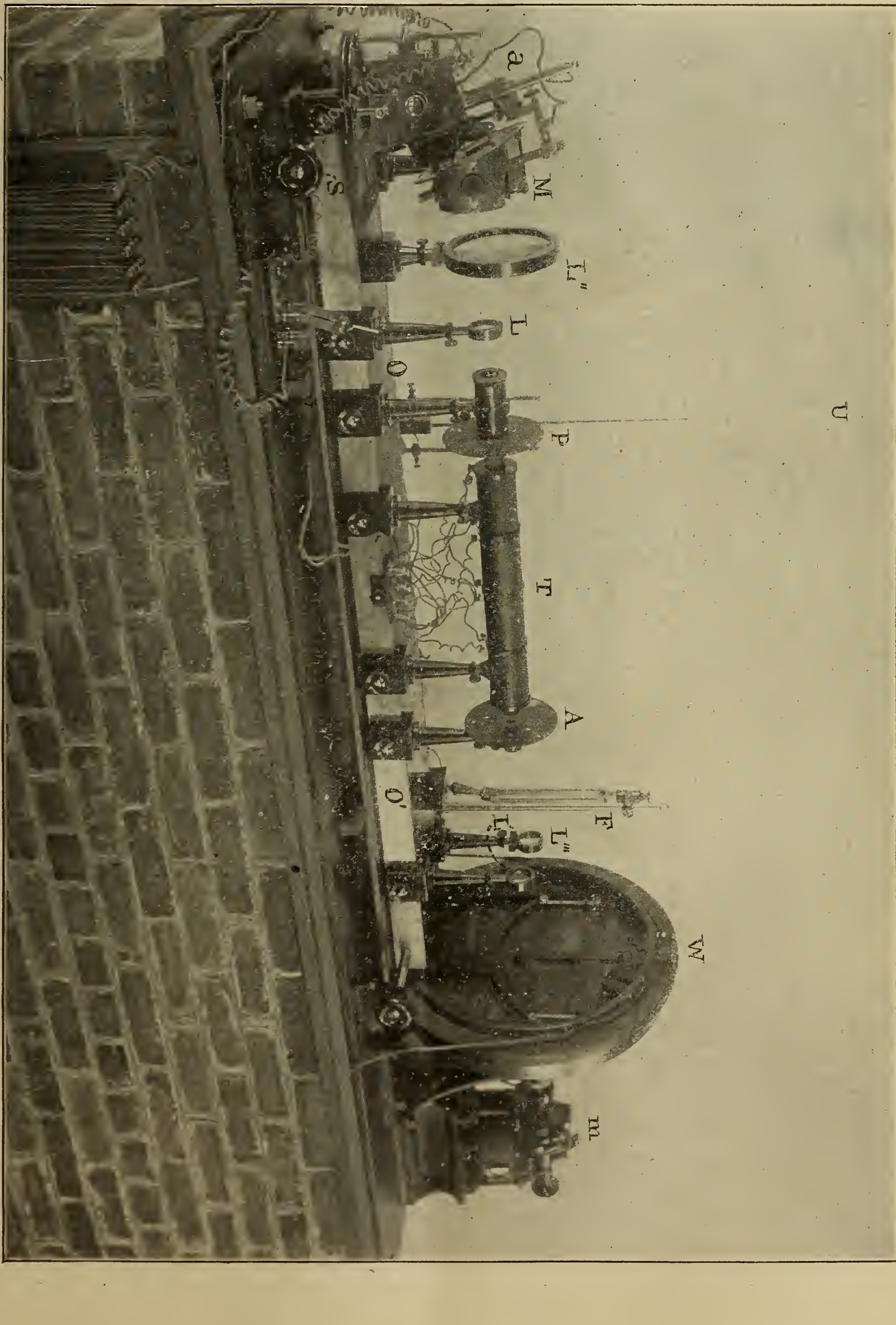


Fig. 14—The Polarizing Photo-Chronograph. (See last week's article, June 10.)

capacity and inductance in series into the line, especially the effect upon the make of an alternating current at different points of phase. Fig. 15 shows the general appearance of the simple alternating current with different exposures, at different speeds of the plate and the same frequency of alternation. In Fig. 10 the inner record C is that of a circuit having 390 ohms resistance, 1.03 henrys inductance, and 4.78 microfarads capacity at a frequency of 137. At each make it is observed that the first wave is small, followed by a large one. The record at D is for a similar circuit in all respects except that the capacity is doubled, being 9.57 microfarads. Theoretical curves* have been computed for these cases and they are in agreement with the records shown.

The method of neutralizing the effects of the distributed capacity of lines by introducing distributed inductance as is now done in some telephone lines, would have an especially useful application in a line employing the alternating current for telegraphy.

Conclusion.

When the extent of the transmission of intelligence at the present time is considered, and the direct influence which this service has upon the development of the world's progress, any proposition which promises to increase its efficiency should be received with consideration.

To better comprehend the volume of this service it is of interest to observe the statistics on the subject. These have been prepared for the United States mail service, the Western Union Telegraph Company, and the American Bell Telephone Company of the United States, and are exhibited in graphical form in Fig. 16. The statistics for the United States Mail service for the last few years were furnished through the courtesy of the Postmaster-General.

It is noticed in general, that there is an increase in all departments of the intelligence transmission service from the earliest dates. The number of pieces of mail sent during 1896 was 5,693,000,000, which is the greatest amount ever sent in a single year. The greatest number of telephone messages on record for a single year is 757,000,000 in 1895. The largest number of telegraph messages was sent in 1893 and amounted to 66,000,000. Thus the greatest number of telegraph messages as compared with telephone messages is in the ratio of 1 to 11½. The greatest number of pieces of mail is in the ratio of 86 to 1 as compared with telegraph messages, or in the ratio of 7½ to 1 as compared with telephone messages. It is also seen that the cost of the mail service of the United States in 1896 was $90,626,000, or about $1.25 per capita. The greatest receipts for any year of the American Bell Telephone Company were in 1895 $16,400,000, about 25 cents per capita, while the greatest receipts of the Western Union Telegraph Company were in 1893 $24,978,000, about 35 cents per capita.

It appears therefore that the people of the United States pay for a telegraph service of about one-eighty-sixth the amount, about one-fourth of that paid for the entire mail service of the United States. It also costs one-and-a-half times as much for telegraph service as for the telephone service, although the number of telephone messages is about eleven-and-a-half times as great.

A conclusion to be drawn from the above general data seems to be that the people are willing to pay more in proportion for a kind of service like that of the telegraph than any other. From the point of serving the people, as well as from a business standpoint, it appears that improvement in this class of intelligence transmission is at present much to be desired. The present state of the art of telegraphy points to improvements along the line of automatic machine transmission.

It is of interest to inquire what effects a system of telegraphy capable of sending continuously 3,000 words a minute would have on the existing methods. To take a simple example of the business between New York and Chicago, where about 40,000 letters are carried daily, it would require but two lines in continuous operation to handle the entire business. At present it takes three days to receive by mail a business reply between New York and Chicago. This transmission by machine telegraphy could be accomplished easily the same day. It is thought that an effect of this would be to increase business transactions to such an extent that the total volume of intelligence transmitted would be augmented, rather than to diminish the business now done by existing methods.

The class of business which such a system would probably at first obtain would be the less urgent telegraph business of greater volume, such as the Associated Press dispatches and newspaper press reports. Among the possibilities is the simultaneous publication of the same newspaper in different parts of the country. For example, in an edition of a daily paper having twelve pages and eight columns per page, making ninety-six columns in all, there are less than 185,000 words. At the rate of 3,000 words per minute it would only require about an hour to transmit the entire contents of the paper. This calculation furthermore assumes that the whole paper is uniformly printed in fine type. It would require a single operator, working by hand and averaging twenty words per minute, over six days of twenty-four hours each to send this amount.

The system proposed is especially adapted to meet the demands of this class of business; for the great flexibility of the alternating current as employed, permits if necessary considerable amounts of power to be transmitted over the line which may be used for making simultaneous manifold copies of the same dispatches in each of widely separated cities. In this manner each of the several newspaper company subscribers in each city receives the identical service with the minimum delay, since each copy received is an original. Each additional subscriber to this service represents no appreciable expense to the company, since it requires but another receiving needle. Furthermore, the use of the alternating current permits the line to be used quadruplex at very rapid speeds, that is, four entirely different dispatches may be sent over one wire at the same time, two in each direction, and any number of copies of one or all the dispatches may be received independently at the same time.

In addition to the above it is practicable to employ the line for a system of the ordinary quadruplex telegraphy at the same time. In trial experiments in the laboratory, particular instructions were given to the operator of the Morse instrument to observe if possible when messages were being sent by the alternating current, and absolutely no effect was detected.

The objection may be urged, that it is already difficult to handle the business at the present rate of operation of the Wheatstone system, and if the instruments worked faster it could not be handled. This objection is undoubtedly a real one in some cases, and it is partly this fact which indicates that it may be easier to inaugurate new methods than to attempt to adapt the new rapid transmitters to the present methods.

A telegraph office of the future will probably present a different appearance from that which may now be seen in any of the large cities. At present in operating the Wheatstone system in this country, sending to long distances at the rate of 150 to 200 words per minute, both those who prepare the sending tape and those who translate the receiving tape are employés of the telegraph company and are near the sending and receiving instruments. If it requires about ten men to prepare tape, and as many more to translate it for a single instrument operating at 150 words per minute, it will require twenty

(Continued on Page 408.)

* "The New Polarizing Photo-Chronograph"—Journal of the U. S. Artillery, Fort Monroe, Va., Nov.–Dec., 1896.

The Electrical Age.

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CONTENTS.

THE MICA INDUSTRY.

It is strange that a misconception of the true status of affairs exists in the legislative departments of this country regarding the use and production of mica. The electrical fraternity, with the necessities of their business confronting them every day of their existence, are better prepared to give an opinion on this subject than those whose life and experience are so different and whose technical opinion is in many respects less valuable than that of a layman. It being obtained frequently from individuals in whom they repose faith and trust but whose words are guided by their desires and advice; such as they give is either the echoed cry of an ignorant multitude or biassed by a love of personal interests which includes gain, or the hoped-for development of their own mines

Great producing centres like India and Canada supply mica in quantity to this country. Laborers are paid for producing it—in India next to nothing; in Canada wages that support life. This strange industry is the means of keeping certain manufacturing concerns afloat without inconvenience. The cessation of importations from the same would almost cause a suspension of their business. It may not be generally known that mica mined in this country from North Carolina and Dakota is hard and only used with the greatest difficulty by electrical engineers, whereas that coming from Canada and India is soft and eminently suited to the demands of practice. Why then should measures be resorted to for raising the price of the imported article and forcing open a lot of mica mines whose produce would flood the market and ruin its present prices by over-production. Mr. Charles W. Jefferson, manager of the Mica Insulator Company, makes the following statement:

"Whatever tax is put upon the mica imported from other countries will not increase the price of mica mined in this country. There is already an over-production. It would increase the price of the soft mica imported from Canada and India, and there would be a stronger tendency than there is now for the electrical manufacturers to use entirely different substitutes. It is due to the electrical manufacturer that he has scoured the world over to find a suitable cheap mica for his purpose, and the present duty of 20 per cent. is a severe tax upon his business, and the question of using mica at all is always before him. If from any cause the price is greatly increased, a great blow will be struck at the mica business, and the miner, whether he be in Dakota or in India, will equally suffer. It will not only be the miner but the electrical manufacturer also. There is no business in the country which has brighter prospects of sending their product abroad than the electrical manufacturer. Only the other day one of them secured contracts in England and Australia entailing an outlay of over one million dollars. In fact they are now looking forward to their export business as their chief outlet, and any tax on them when competing with Germany and England—and the one on mica is about the only one—might result in a loss to the foreign business to the amount of millions of dollars.

"Mica, by the by, has played no unimportant part in securing these contracts. Owing to its large use American insulation stands very high abroad.

"This debate about mica in Congress shows a general pressure put upon the various representatives for a higher duty on mica. This pressure has come from those who own a bit of land with mica upon it. They are not in a position to know if a duty would help them or not. I most emphatically say that it would not. The remedy is a greater demand, not a higher price. I may be like one crying aloud in the wilderness, but for the benefit of the miners, the thousands of men and women who are employed in working the mica after it has been mined, and for the mica business generally."

There are then two views taken; that of the countries' representatives and that of the manufacturers. The wisest course to pursue is not that of raising the price of mica, simply because such a remedy seems to be the best, but the appointment of a committee of level-headed men whose investigations will be conducted systematically and unbiassedly, and whose conclusions will be drawn from the present state of the mica trade, its centres of production and consumption.

Electricity from the Nile Cataracts.—Prof. Forbes, the electrician, who has just returned to Cairo from Wady Halfa, expresses a highly favorable opinion about utilizing the power of the cataracts for generating electricity, and considers the general circumstances of Egypt exceptionally well adapted for its use as motive power. Irrigation could be extended as well as cheapened by the saving in cattle, and especially in coal, which becomes enormously dear in Upper Egypt owing to the expenses of transport from Alexandria. He considers that the cataract power would be available all the year round for working the railway, cotton ginning mills, sugar factories, irrigation machines, etc., also that it could be supplied over distances of several hundred miles at a cost much below that of coal. Prof. Forbes is leaving for England, but will return in September to make a complete survey and present the Government with a project for utilizing the electricity to be generated at the Nile cataracts.—London Invention.

times this working force for one of the rapid machine transmitters. Evidently changes would be required in the present methods to handle this business.

as now, but the tendency of the offices proper will be to transmit and receive letters already prepared rather than to undertake the preparation of the letters as well. The

Fig. 16.

It is thought that a telegraph company of the future will fulfil a somewhat different function from the present ones. The company will own its wires and rights of way

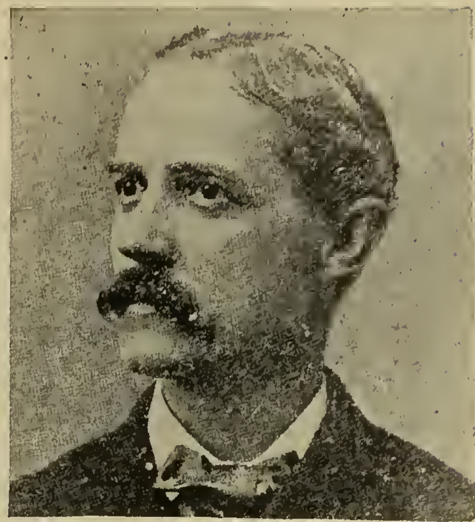
income of the company will be derived from the rent of its lines at a fixed price per minute, or a fixed price per hundred words. The service of the telegraph office then

becomes like that of the post-office, its duty being to receive and deliver letters already prepared, as the post-office does. The difference between the two offices is in the manner in which this is accomplished. The telegraph office becomes a post-office which employs an electric current in a copper wire to carry its letters instead of a railroad train. The advantages in point of speed of delivering letters by the former method are apparent. Instead of requiring twenty-four hours to deliver letters between New York and Chicago, it will require but a few hours at most, and make it possible to receive a reply the same day. It is probable that such a system would take more business from the present postal system than any other; for when telegraph letters can be sent at reasonable rates comparable with postage, in a few hours instead of many days, a certain amount of present post-office business will be diverted. More than this, when business can be done with greater facility than at present, the total volume of business will undoubtedly be increased, because transactions may take place in a day which formerly required a week.

It would be to the interest of such a company to seek that class of less urgent business now done by correspondence, rather than the class handled by the present telegraph companies, where the highest speed of delivery is expected. If one trunk line becomes established between large business centres, it will draw business from a surrounding area. For instance, if a line were established between New York and Chicago, and a person in Albany desired to communicate with Chicago or points beyond, it would be quicker to send the letter to New York for transmission over the trunk line to Chicago, and then by rail to its destination, than to send directly by rail from Albany. With a few trunk lines in successful operation it would not be long before they would be multiplied.

It is understood that these telegraph letters are sent by mail in envelopes in the usual manner, except that the envelope contains the prepared message ready to be sent through the transmitter, and thus the telegraph office becomes relieved of the preparation of the letters which is not strictly a part of its business. When the system comes into general use, business offices will have their own perforators, and it will become necessary for the operator to learn the telegraph alphabet as a part of his preparation as a stenographer and typewriter. The three-key perforating machine is comparatively inexpensive, but undoubtedly a machine could be devised at an early date, as an attachment to the present typewriter, for the purpose of perforating letters at the same time that they are being written by the typewriter in the usual way. This could be constructed to operate by the use of electro-magnets, and can be attached to a typewriter without interfering in any way with its operation. No extra power would be required, for this can be derived from an electric current which operates the attachment. The writing may be perforated at the present rate of speed of typewriting without the operator having any knowledge of the telegraph alphabet as far as perforating is concerned. This machine will cost more than the three-key perforator, but it would in a short time more than pay for the difference in cost on account of the great gain in speed, and also because it prints a copy of the letter which may be kept on file. Before these perforators are introduced into common use it will be necessary to establish offices in the immediate vicinity of the terminals of the trunk lines, to prepare letters for persons furnishing printed or written copy, as well as to furnish a printed translation when desired of letters received from the central office. The opportunity to obtain a cheaper rate for prepared letters will act as an inducement to those employing a stenographer to add a perforator to their offices.

(To be continued.)



Geo. F. Forter.

GEORGE F. PORTER, secretary of the N. E. L. A., has been appointed manager for Wm. Brixey, Kerite Wires and Cables, 203 Broadway, N. Y. Mr. Brixey is to be congratulated on securing the services of so able a manager. Mr. Porter was a representative of the Western Electric Company, of New York and Chicago, before he was appointed secretary of the N. E. L. A. some five years ago. The N. E. L. A. was never in a financially good condition until Mr. Porter took the helm. His acquaintance throughout the United States will be of great benefit to Mr. Brixey. We wish him every success in his new position, and we know that his numerous friends throughout the country will be greatly pleased to learn of this change in Mr. Porter's position.

A TRIBUTE TO ELECTRICAL JOURNALISM.

It fills us with the deepest satisfaction to receive from one whom we esteem and respect an unsolicited letter of dignified approval. We place it before the reader as it was received, feeling that this recognition of our efforts should be published in the same frank spirit that it was written. It is French style to exchange compliments, yet we forbear, in this case, knowing that a lightning stenographer would be required to do justice to our sentiments regarding him:

Toronto, June 21, 1897.

The Editor of Electrical Age, New York, N. Y.

Dear Sir:—My term of office as president of National Electric Light Association expiring on the 1st, proximo, I desire as one of the last acts of my administration to thank yourself and the editors of other electrical journals, officially and personally, for the interest you have shown in the work of the Association during the past year, and for your kindness in promptly publishing any information that has been forwarded to you for that purpose by the association.

As I took occasion to point out in my annual address, the electrical industry at large owes a debt of gratitude to the electrical press, and for my part I am glad to have had an opportunity of acknowledging this obligation.

Yours very truly,

Frederic Nicholls.

OBITUARY.

Eugene E. Bogart, son of the late Abraham L. Bogart, the well-known manufacturer of electric gas-lighting apparatus, of No. 22 Union Square, N. Y. City, died on the morning of June 24, from the result of injuries received from being thrown from a cable car in this city, on February 5 of this year. Mr. Bogart succeeded to the business of his father, who died suddenly July 25, 1896. The deceased was forty-five years of age and leaves a widow and three grown children. His brother, A. Livingston Bogart, the well-known electrician and electrical expert, is the only remaining son of Abraham L. Bogart. Mr. Bogart was very popular and liked among the trade, and we sincerely condole with the widow in this hour of affliction.

RAILWAY MOTORS AND CONTROLLERS.

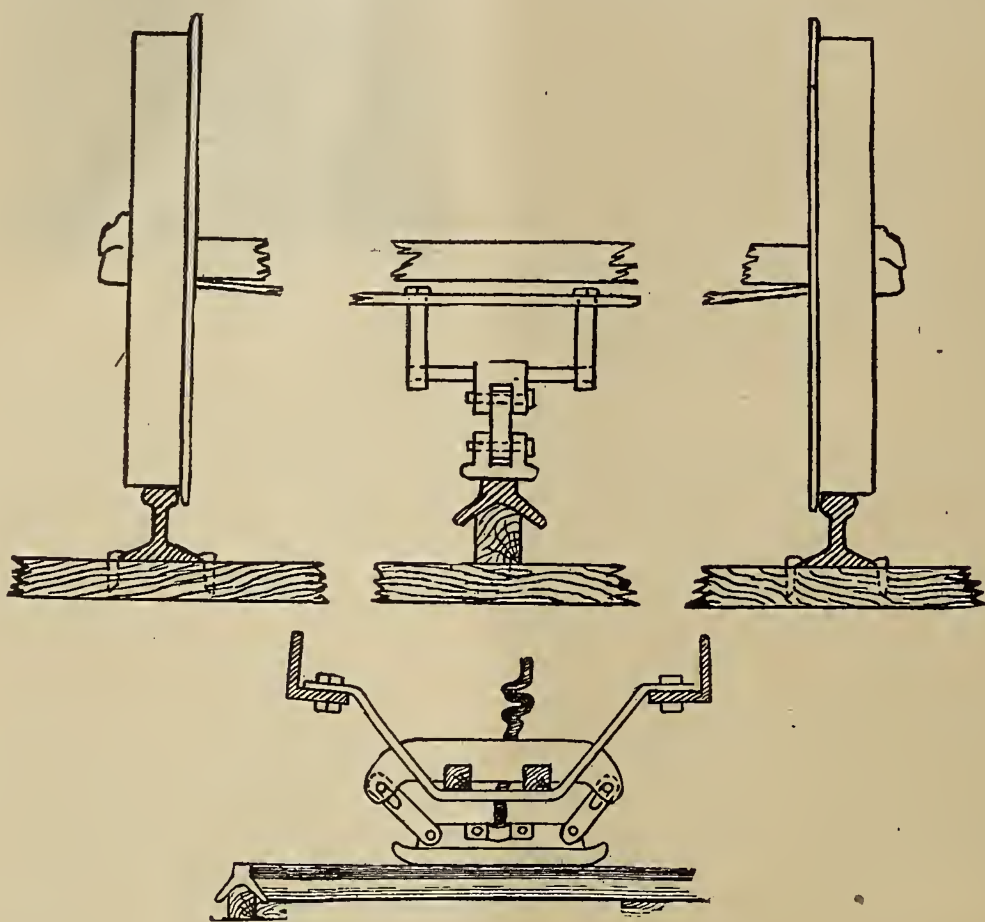
LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The use of motors for track service is limited to those of the series type. A series motor possesses advantages over the shunt that both experience and theory advocate. The current flowing through a series motor passes from brush to brush via armature and field. The speed and pull of the armature can be changed at will by varying the pressure applied to the armature and its current and field.

The pulling power of any armature depends upon the
(1) Current in the armature.
(2) Strength of field.

The series motor is naturally adapted by its construction to an easy system of regulation. Not only can the current be varied outside by having a rheostat in series with the motor, but the magnet coils can likewise act in



Details of Third Rail.

Third Rail Car Equipment.

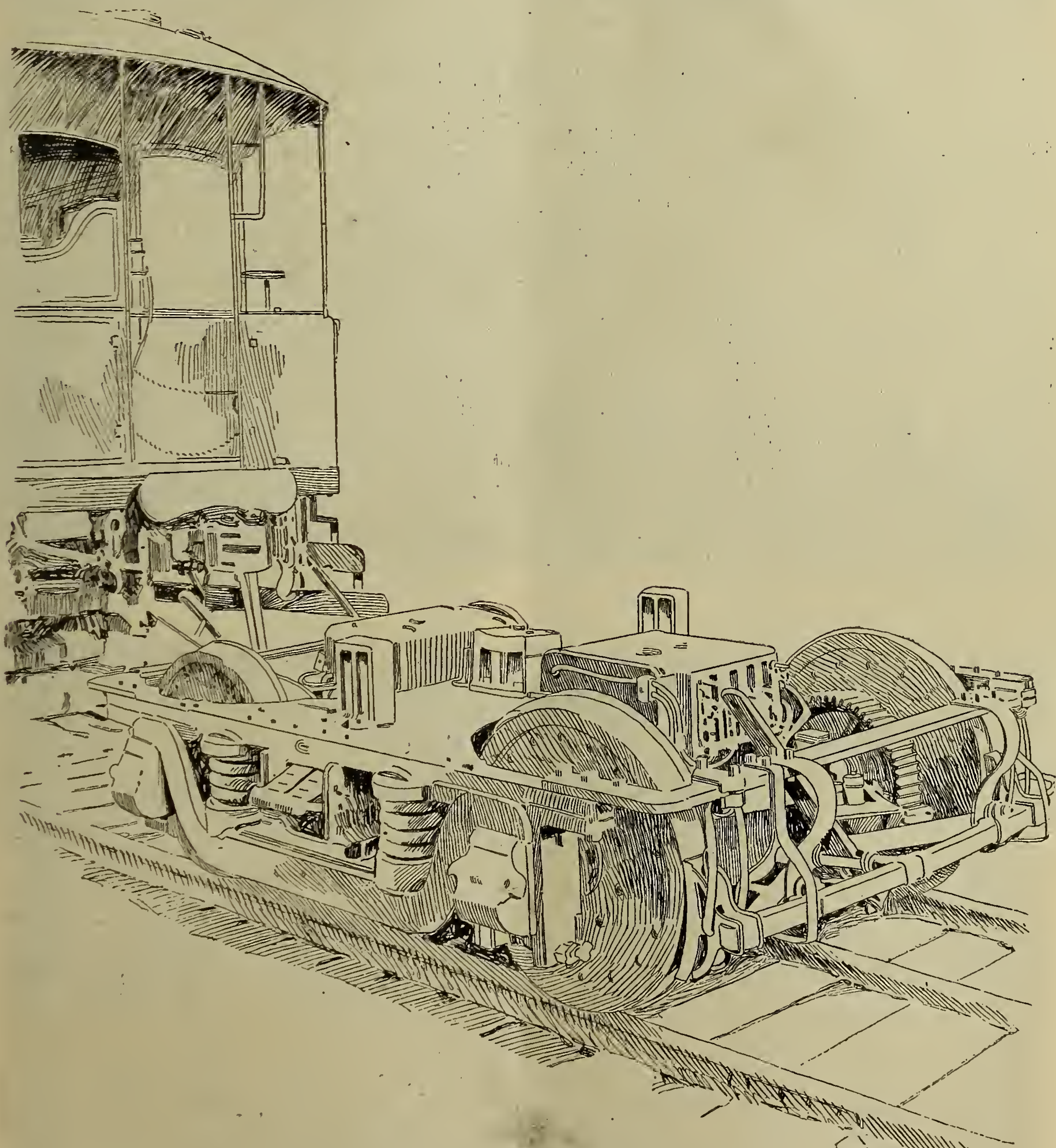
this capacity by being subdivided. A series motor connected to a rheostat and having commutated or subdivided field coils can be regulated both in speed and power by these means.

A trolley car is usually equipped with two motors. They are both series motors with commutated field coils. A small rheostat is in series with the pair. To vary the speed and pull of the car an automatic switching device called a controller is used.

Function of a Controller.—When the car is at rest the rheostat and both motors are in series. To start the car and put it through its different speeds, the controller, which consists of a cylindrical vertical commutator, is revolved. The general result is as follows:

The heaviness of motor cars has necessitated the use of strong steel rails and a secure bond. The cars used are not very different from the old horse-car style, except that they are better furnished, more capacious and in every respect more comfortable. Both station, track, car and motors are a source of expense to the company. The station has machinery which depreciates; the track requires many repairs unless well put down. and even then the rails wear out; the motors have armatures which constantly burn out and the cars become scratched and shabby from daily use.

Trolley lines running over hilly ground are apt to incur more expense from repairs than those installed on more level road. The reason for this is traced to the



Truck Exposed—Third Rail System.

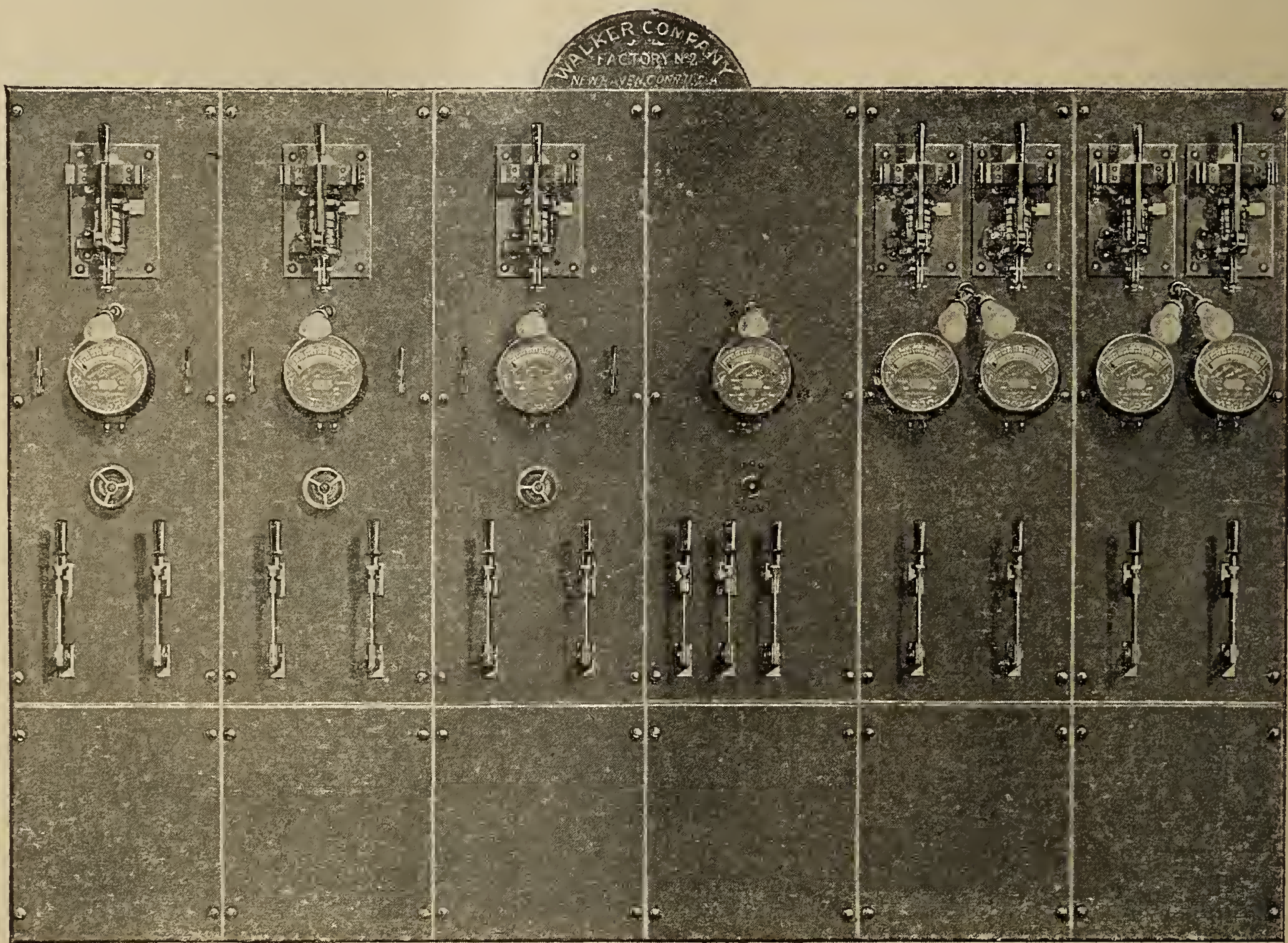
(1) The rheostat and two motors in series.
(2) The two motors thrown in multiple.
(3) Subdivided fields thrown into multiple.

To each of these general processes there are subdivisions; that is, the rheostat contains steps which regulate to some extent—the motors may be thrown in multiple, or their fields and armatures separately, and in addition different combinations may be made of the commutated fields. The practical result of all these changes is to increase the current flowing through the motors by successive stages until the pressure and current is at a maximum.

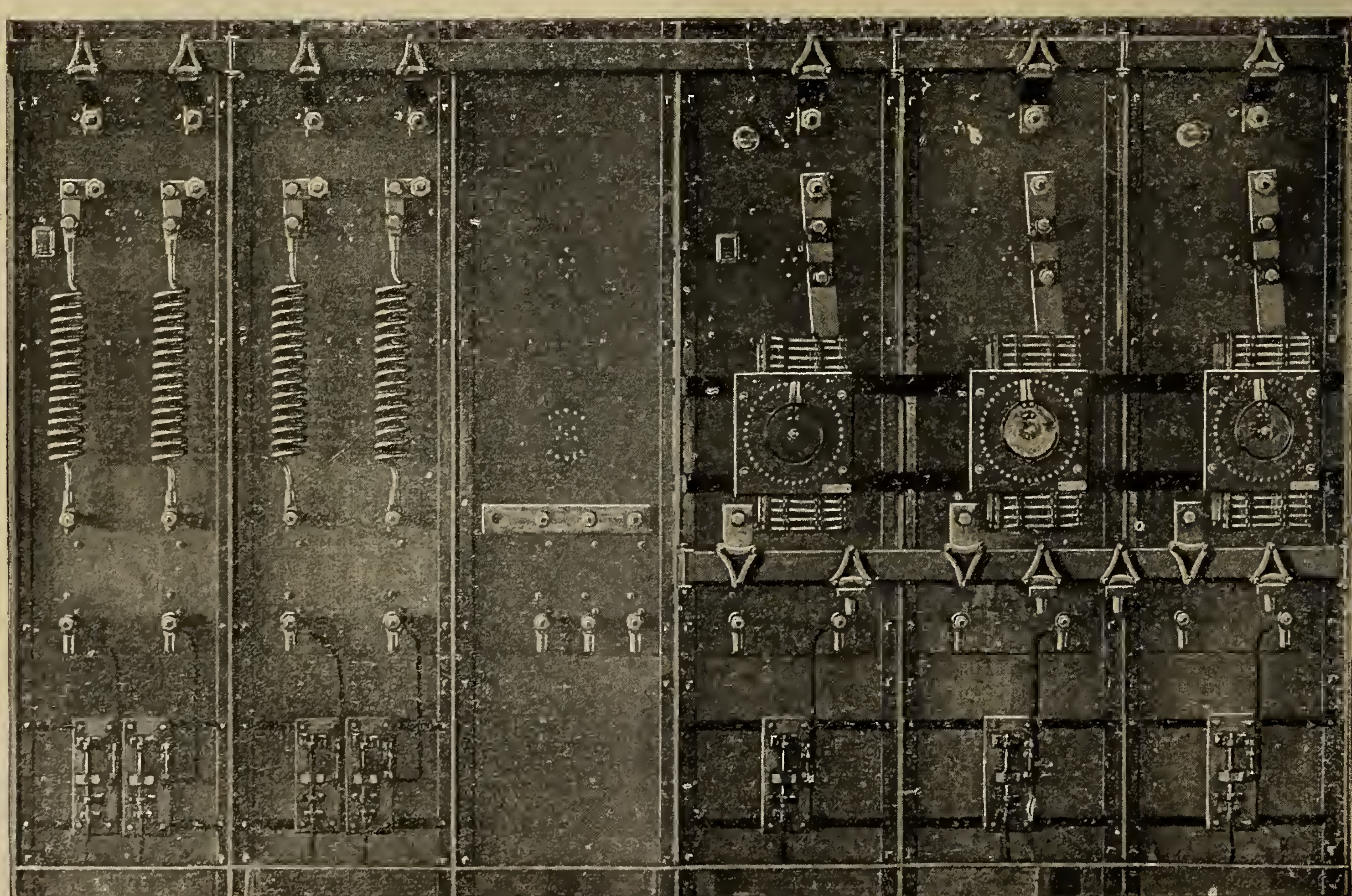
greater strain upon the motors when climbing hills. The work the motor performs is divisible into two parts—that of advancing and that of lifting itself the height of the hill. In certain localities it seems evident that a cable system would be best; that is, a very hilly district. Block electric, open conduit and storage battery systems are occasionally heard of. In New York City, perhaps, the conduit system is receiving the best trial of all. Several of our largest railroads are about to permanently adopt electric cars for special purposes; the B. & O. being the most prominent of all.

SWITCHBOARDS AND THEIR EQUIPMENT.

A great electric light plant with its throbbing centre of electrical distribution, its various circuits spreading out in many ramifications and its points of control all guided plant is the switchboard. From it spread the wires that carry energy to various circuits of lamps or motors for lifting, carrying or ventilating. The switches upon it place these main lines under absolute control, the meters register the current and pressure and the circuit breakers



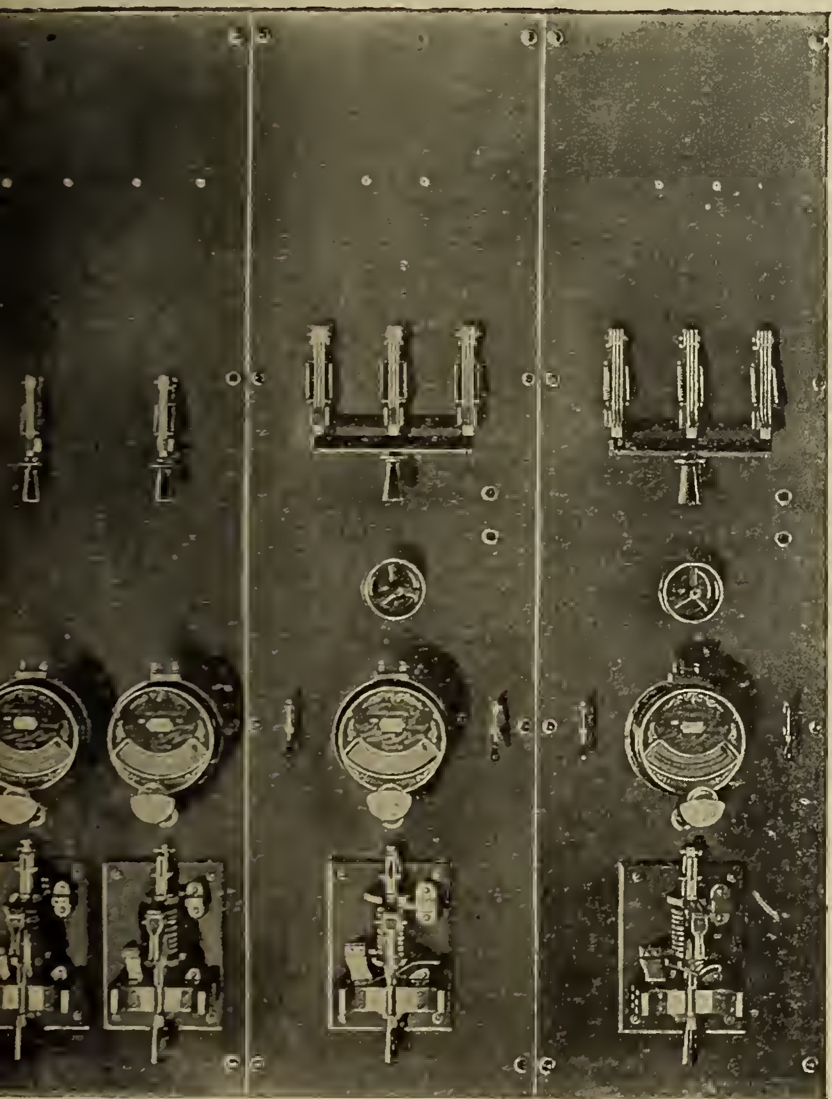
Six Panel Railway Switchboard.



Back of Six-Panel Railway Switchboard.

to one piece of mechanism, the switchboard, has frequently been compared with the human body, whose nerve ganglions and untiring heart is functionally the same. The great nerve centre of an electric light station or private prevent any disastrous rush of current from occurring. The board itself is made of material to stand the possible burns and scorches that are apt to scar or set it on fire. The triple duties of a switchboard are therefore evident

to the analytic mind; they are the control, measurement and distribution of the current. A fireproof board, good switches and accurate meters will make this problem easy of solution. For convenience sake switchboards are divided up into divisions or panels, whereas in railway work the control and measurement of a certain portion of the plant is particularly desired. Such divisions or panels may be devoted to the kilowatt output of a single machine, the measurement and control of the feeders or the purpose of controlling and measuring the entire load. Panels may therefore be individually called generator panels, feeder panels or main panels. Two of the illustrations show the front and back of a six-panel railway switchboard, manufactured by the Walker Company, of Cleveland, Ohio.



Front View of Railway Switchboards made for Cleveland and Chagrin Falls Electric Railway Co., Chagrin Falls, O.

The Generator Panels made by the Walker Co. are perfectly equipped with illuminated dial instruments. Two single-pole switches for the throwing of the leads onto the line and an equalizer switch placed on a separate pedestal or on the main panel are supplied. The switches are multiple jawed and carry an overload of 50 per cent.

The rheostat is of the improved enamel type operated by a handle on the front of the board. Push buttons control the ammeter and voltmeter. The voltmeter push button automatically disconnects from the "bus" bars when pressed and attaches to the generator which that panel is devoted to. There is no voltmeter switch and no live contacts on the front of the board.

The Main Panel.—On the main panel are mounted instruments that are too important to be placed elsewhere, as for instance the summation ammeter, which measures the entire station output, wattmeter ground detector, etc. A voltmeter is mounted on this panel which will indicate the pressure of each generator respectively upon turning the connecting switch to any desired machine.

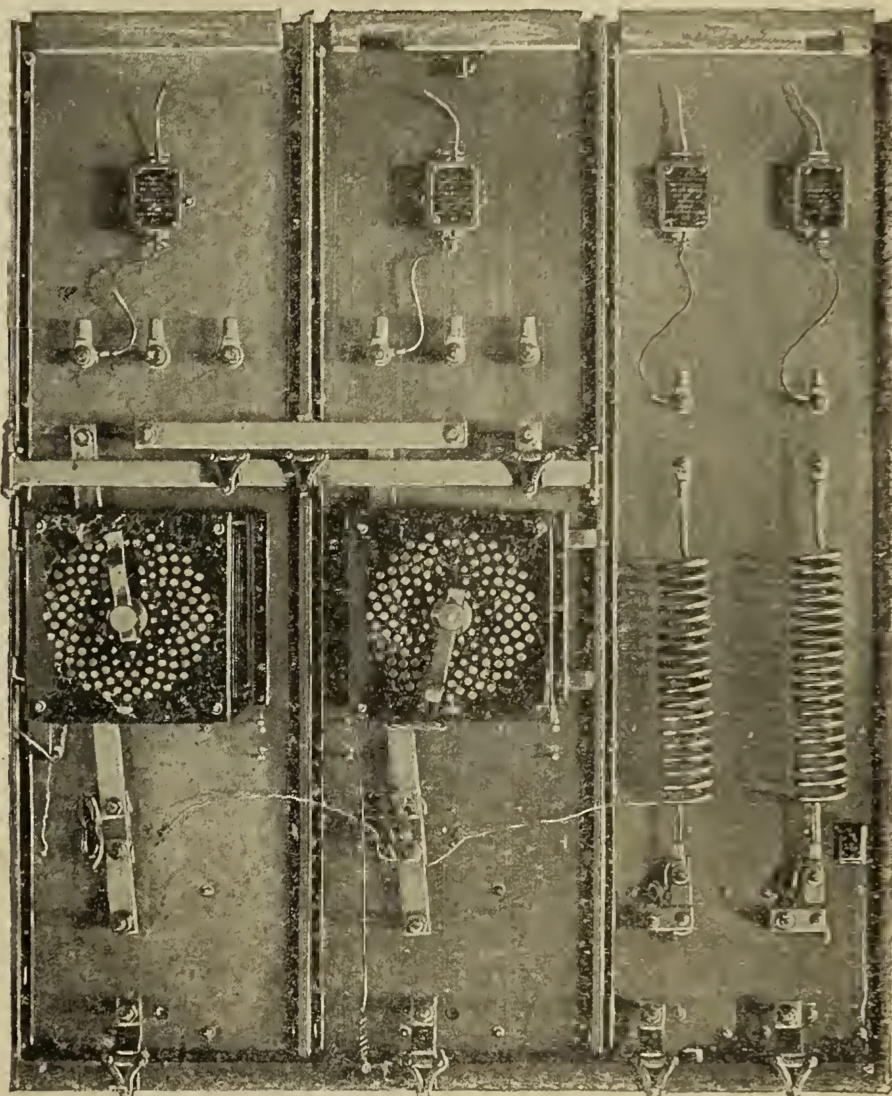
The Feeder Panel is so equipped that the feeders take their power from a positive "bus" bar on top of the board. They then connect with a single-pole circuit breaker, an ammeter and a kicking coil which opposes static discharges. A charge of this description, on entering, is retarded by the kicking coil and sent to earth by the lightning arrester at the bottom of the panel.

Illustrations are given of the equipment of several boards built up of sections on the panel system. The utmost satisfaction prevails among those utilizing boards built by the Walker Co.

THE DAYLIGHT WORK OF CENTRAL STATIONS*

BY THOMAS COMMERFORD MARTIN.

The development of the central station industry has been, in some respects, a disappointment. We have now



Back View of Railway Switchboard made for Cleveland and Chagrin Falls Electric Railway Co.

had nearly twenty years of central station work in this country, and have witnessed an enormous growth in that period within the field of work covered by this organization, but it is apparently as true today as when the association was formed, that the companies restrict themselves injuriously in their natural and logical advance by remaining mere lighting corporations. What would happen to us all if some new lighting medium came into vogue that deprived us of our illuminating business entirely? If we had to fall back on daylight work, might we not be better off?

That question suggests an extreme view of a rather impossible situation, the fact being that electricity, as an illuminant, gains steadily in public estimation, and has at this moment, no new rival within speaking distance. But there is vital importance in the opinion of a local company as to whether it exists only to furnish light, or, on the other hand, to supply current for a variety of uses, new and old. My own opinion, modestly expressed, is that the intrinsic value of a company rises just in proportion as it gets off the lighting basis and builds itself up on

*Read before the National Electric Light Convention, held at Niagara Falls, June 8, 9, 10, 1897.

that of current; just in proportion as it ceases to limit its activities by a moonlight schedule, and, like the British drum-beat, chases the sun with an insatiable desire for more territory and more trade.

A brief retrospect will not be out of place, if followed by a study of the present situation. It is as well not to go back further than 1886, for, although arc lighting is a full decade older than that, the industry ten years ago took its great leap forward. A careful investigation shows that, in 1886, there were about 410 central stations in this country. Of these, only 300 furnish available statistics, and it would appear that 226 of the companies were then only doing a night arc lighting business. It is safe to assume that all the companies which did not report were in the same category as the 226; so that out of the 410 local companies, some 325 were doing business only between dusk and daylight, and were standing idle all the rest of the time. In other words, taking the year through, they were idle nearly two-thirds of the day, if the average running be taken at 3,000 hours a year.

To what degree have these conditions been improved in the ten years? This is an extremely difficult question to answer, but a few tentative figures may be acceptable as a basis for study and discussion. At the close of 1896 there were about 2,400 central stations in operation in this country, so that in ten years the number had increased sixfold, a gain that is simply stupendous. Of these 2,400, however, 975 had, from the figures obtainable, no day circuits, and 220 others had only arc apparatus, so that 1,195 local companies, by their own admission, were limited to night work. The case is not, however, so encouraging as might be implied from these figures. Of the remaining 1,200 companies, only 327 report day circuits, and if it is safe to assume that half of the 900 companies and plants not giving these details were without day circuits, it would appear that, out of 2,400 local plants, at least 1,500 are limited to the night hours for their earning capacity. It must be noted, however, that nearly all the 900 companies not specifying day circuits are operating incandescent circuits, very largely with the alternating current, so that the means for day operation are generally there under more or less favorable conditions.

It is obvious at once that an immense amount of capital and machinery are standing idle that might otherwise be productive of profit and dividends. Of the 1,200 companies confessing that they have no day circuits, only some 780 give their figures of capital and generating capacity in steam or water. It would appear that these plants, with a moderate capitalization of $46,908,000, and with an engine and water-wheel capacity of 164,000 horse-power, are standing idle two-thirds of the day and often a great deal longer.

Such figures are given broadly, and may be a little inaccurate in precise detail, but it is the mere fact that is so striking. It is obvious that these figures apply to the great bulk of small stations. And yet some of them are certainly not small. At least sixty-five or seventy of them have each a capacity of 500 horse-power and upwards, and several of them are legitimately capitalized at above a million dollars each. A company of such size ten years ago was rare and exceptional, and would have been difficult to start, except on the general hypothesis that its business would include something beyond simple street illumination, with a little house lighting thrown in. It may be doubted whether capital of any magnitude could be enlisted today for a company that had no ideas beyond ordinary lighting work.

Without presenting this state of affairs as a cause for alarm, or intending to imply that a business is necessarily on a bad basis because limited to a few hours, it is not improper to inquire whether there is no chance for improvement. It can not be said that local lighting companies have become notorious, like some gas companies, for paying large dividends; so that a slight amelioration of financial condition might not be objected to. Even trolley roads, running every hour of the day, find it difficult, sometimes, to make ends meet, but they have the satisfaction of a continuous use of their plant and of knowing that they get all the business that offers. If there is any sufficient reason why a local lighting company should operate its generating machinery fewer hours than a trolley road, it has not made itself specially manifest, except in one direction, which will be briefly referred to in a later paragraph. I believe every gas company is on a twenty-four-hour basis of supply.

(To be continued.)

In the old days a journey to the Adirondacks was not much less formidable than was a voyage to Europe. Then the traveler journeyed by rail to Westport, on Lake Champlain, or to Keeseville, near Port Kent and thence penetrated the mountains by stage, a tedious journey. Now he can go away through to his destination in the heart of the woods in ten or a dozen hours from this city, without a change of cars, and occupying a seat in a parlor car or a berth in a sleeper—a trip so comfortable and speedy that he thinks nothing of running up to the mountains for a day or two to attend personally to the matter of engaging board for the summer. But this would not have been obtained had not the railroads pushed their tracks and their trains into the wilderness and, by overcoming time and distance, brought the whole region close to the metropolis, and made it easily accessible also from New England and the West. Only half a dozen years ago the Adirondack and St. Lawrence road, now the Adirondack division of the New York Central, and otherwise known as the Mohawk and Malone road, was built through the forest, connecting Utica with Malone. A large summer traffic was immediately created, and all the resorts of that part of the woods benefitted by the construction of the new line. The track is well ballasted and smooth to ride over, and at convenient intervals are neat stations, at which travelers by rail leave the cars to enter stages or tally-hos for the second and final stage of the journey to their summer home.

The New York Central, with a view to meeting the requirements of that large class of occasional travelers, who can get away but for a short vacation each year, has arranged a series of specially reduced rate tours for this season, occupying from two to fifteen days. These tours embrace visits to the Adirondacks, Saratoga, Lake George, Thousand Islands, Montreal, Niagara Falls and the leading resorts in New York State and Canada.

A copy of "Two to Fifteen Days' Pleasure Tours" will be sent free, postpaid, to any address in the world, on receipt of a two-cent stamp, by George H. Daniels, general passenger agent, Grand Central Station, New York.

LECTURE ON THE DIRECT CONVERSION OF ELECTRICITY INTO HEAT.

(Continued from page 390.)

When we get to this point, we conclude, after the machine has gone through all that baking and testing, that it is worthy to be put together in the form of a machine, so we take these bottom and top plates (illustrating), and put one on here, bottom plate here, top plate here, and then we put on this outer cover which forms a water-jacket and solder that on, and when we have done that, we make a test under 15 pounds water pressure for leakage; after the water pressure has been completed we submit the machine to heat, slowly applying it, in order to thoroughly vitrify the inside, and then we make final resistance test of the machine; and if the resistance test, after this test has been applied, corresponds with the resistance test as originally made from the five rows of elements, we conclude that the device is then worthy of being put out and it is then finished. But

before it is sold it is always subjected to one week's work. I am not the slightest bit alarmed at the possibility of the fan on the table which is run by one of these machines stopping. Of course, it might. I cannot guarantee that; with all our precautions, some machines are going to be defective, but the chances are that fan is not going to stop revolving. Now, we have brought it down to the completed machine, to a machine such as this (indicating). There is, however, one other point which comes in here, and which you will concede is an important point, and which most people give as the most important point in thermo-electricity—and that is, how much heat do you use?

Taking that machine, as it is running now, we find there is about two and one-half cubic feet of gas used in the machine for the work which it is now doing; that costs, I believe, at the ordinary rate of New York gas, which is extremely high, three-tenths of a cent to operate that fan motor per hour. In the heating of the device the problem is this—in the first place we have a device which is small in circumference, so that we can confine the heat as closely as possible, and following that, we have this deflector (illustrating), which gradually increases in size; it is a simple device, the hottest part of the flame being at the bottom; it is the smallest in the deflector bar, and is further away from the sides of the device, and the higher up the flame goes the larger it gets, and the greater the heat is confined the higher up it goes. The device works very efficiently. You may say that the deflector bar, being iron and working at a red-hot heat, will burn out. No; strange to say, it does not burn out, because there is a curious provision of nature, in the shape of some form of carbon deposit, which gas ordinarily gives off when burning as a Bunsen burner, and by using that Bunsen burner the way we do, throwing it on the red hot disk, this gas or this waste product of the gas, is formed on there in the form of a scale. It is what is known as "barfing" in mechanics.

This formation barfs this device so that it is coated and there is no further action on it. You may say that the coating will get thicker and thicker until it will become objectionable. When it becomes of a certain thickness it naturally breaks off; especially when the gas is put out, you will hear a snap in the machine and you will find that little particles of this scale are being broken away. The deflector, even if it was destructible, can be replaced for a very few cents. I know of nothing in the machine, except the deflector, in which there is a question or probability of renewal.

Now, after stating how this machine is made, and how the heat is used, the question is, To what extent have you succeeded in making a practical machine? There is no doubt whatever that it is producing electricity. There is no doubt that it is producing it direct from heat. We see this in the machines on the table. But how far will the device be used? I think the best way will be to show some of its uses. I will operate this six-inch gong, this medical coil, this telegraph instrument and these fans. I think the best way, possibly, to get information on the subject is to have the matter open for discussion. You recognize the fact that this is a commercial device which is on sale, and possibly I am presuming in talking to a scientific body on a device which can be purchased in open market. One of these machines will ring twenty-six inch gongs at one time. It can be used in telegraph work, and has been so used very successfully. It will operate this induction coil, ring the bell and operate the telegraph instrument all at the same time. I will let your own judgment say whether or not the device is valuable. You must remember it is using only 2½ feet of gas per hour, which costs three-tenths of a cent in New York; in England it would cost about one-tenth.

(To be continued.)

Park Rapids, Minn.—An electric light plant is to be established.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(Q.)—STORAGE BATTERY FOR TWO LIGHTS.
Editor Electrical Age, New York City.

Dear Sir: As I am desirous of constructing a portable storage cell which will light two 16-candle power lamps, I hereby apply to you for the necessary information concerning the size of plates, cell, etc.

Yours respectfully, W. U. T.

(A.)—A portable cell to run two 16-candle power lamps will have a size and weight entirely dependent upon the number of hours the two lamps are to burn and the voltage of the lamps. Let us know—

(1) The number of hours the lamp will be lit.
(2) The voltage of the lamps.

(Q.)—WELDING BICYCLE TUBING.

Albany, June 3, 1897.

Dear Sirs: I have heard of a method of joining bicycle tubing so that it becomes seamless, thus making it better and stronger than the regular kind sold. Do you think it possible to substitute welding for brazing in the construction of a bicycle frame? The heating and uncertainty of results may be dispensed with if the above method has any features of value. Pardon the space I occupy. Hoping to receive a speedy answer, I remain,

Yours respectfully,
Alfred R. Gibbons.

(A.)—The seamless bicycle tubing can be bought at any large general supply company. The welding of frame parts together might be attempted with good results. We know of no case in which the entire frame was joined, but think that the solidity and strength would not be greatly enhanced. If the brazing is poorly done the danger of riding the wheel is no greater than if the welding is imperfect.

(Q.)—CAR CONTROLLERS.

Schenectady, June 3, 1897.

Electrical Age.

Dear Sirs: Electric railroads have been a sort of hobby with me for the last few years. But in spite of that my theoretical knowledge of the motor is very small. The car controller has often bothered me because, although the connections were not hard to understand, I do not see why the changes in speed occur, and take this opportunity of asking you to explain the same.

Yours respectfully,
R. T. Hope.

(A.)—Each move of the controller alters the resistance, the motors as a whole, the armatures, fields, etc., being thrown into parallel.

The reason why a car increases in speed is because the increased current in the armature and stronger field enables it to exert more torque and hurry the car forward. Generally speaking in motors this rule may be followed. The speed increases with the volts and the pull increases with the current. The combination is effected by means of a controller, the pressure and current being undoubtedly increased.

Minneapolis, Minn.—J. T. Fanning, engineer, is building improvements on the upper Missouri, near Helena, of 8,000 horse-power. The power is to be transmitted electrically and used for East Helena; also to electrically light Helena, and furnish power for the street-car service.

Olean, N. Y.—The Olean Electric Street-Railway Co. has increased its capital stock to $300,000. A six-mile extension to Portvile is to be constructed.

POSSIBLE CONTRACTS.

Auburn, Ill.—Address Town Clerk, concerning electric light plant to be installed. Local election recently, and favorable to this enterprise.

Jackson, Miss.—D. D. Porter, Jr., City Clerk, may be addressed concerning lighting of streets with electricity.

Greenville, S. C.—J. S. Lawrence, of Charleston, S. C., may be addressed concerning electric railway, which is to be constructed in Greenville by new company, which has obtained franchise for same. A power plant will be erected for supplying electricity.

Georgetown, Tex.—The McElroy-Brett Electric Co. will establish a new electric light plant.

Washington, D. C.—The capital Railway Co., A. H. Walker, engineer, will erect power-house at cost of $2,500.

Jackson, Miss.—Frank Sharp, of Chicago, has been granted franchise for construction of gas works, electric light plant, electric street-railway, etc.

Carthage, N. C.—W. H. McNeill is interested in establishment of water supply and electric lighting sytems.

Milledgeville, Ga.—The Mayor may be addressed concerning establishment of an electric light plant.

Griffin, Ga.—It is reported that B. R. Blakely will not erect electric light plant.

Greenville, S. C.—J. S. Lawrence and others have been granted a thirty-seven years' franchise to establish an electric street-car system.

Grand Forks, N. D.—City Clerk may be addressed concerning construction of a new electric light plant to cost $21,000.

Morris, Minn.—Wells Bros. & Hanson will light their store by electricity.

Park Rapids, Minn.—Geo. Mandigo is interested in the establishment of an electric light plant.

Fisher, Minn.—An electric light and telephone system will be established at Fertile.

Redfield, So. Dak.—Work on the electric light plant will shortly be commenced.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued January 19, 1897.

575,322. Incandescent Lamp Socket. R. B. Benjamin, Chicago, Ill. Filed March 16, 1896.

575,332. Electrically Illuminated Jugglery Apparatus. M. Cronin, London, Eng. Filed October 30, 1896.

575,341. Clutch for Arc Lamps. E. Finkbeiner, Brooklyn, N. Y. Filed July 27, 1896.

575,346. Electric Railway. W. Grunow, Jr., Bridgeport, Conn. Filed Oct. 28, 1895.

575,354. Electric Rail Bond. W. Jens, Johnstown, Pa. Filed June 30, 1896.

575,366. Electrical Controller. W. H. Morgan, Alliance, O. Filed Sept. 4, 1895.

575,388. Rail-Bond and Connection. M. K. Bowen, Chicago, Ill. Filed Oct. 9, 1895.

575,394. Magneto-Telephone. S. D. Field, Stockbridge, Mass. Filed Aug. 11, 1896.

575,419. Telegraphy. P. B. Delany, South Orange, N. J. Filed April 21, 1896.

575,449. Telegraph Battery Jar. A. L. Werner, Delano, Pa. Filed June 29, 1896.

575,454. Series Multiple Controller for Electric Motors. E. M. Bentley, Lawrence, N. Y. Filed Nov. 13, 1896.

575,479. Electric Elevator or Hoisting Machine. R. M. Hunter, Philadelphia, Pa. Filed April 5, 1894.

575,488. Floating Traction Device. T. P. Milligan, Cambridge, Mass. Filed March 26, 1896.

575,499. Means for Operating Electric Motors. J. F. McLaughlin, Philadelphia, Pa. Filed Sept. 1, 1891.

575,523. Push Button. C. O. Mailloux, New York, N. Y. Filed June 4, 1896.

575,573. Electrical Controlling Apparatus. O. H. and A. F. Pieper, San Jose, Cal. Filed Dec. 19, 1895.

575,601. Railway Signal. W. F. French, Omaha, Neb. Filed April 23, 1896.

575,615. Electric Motor and Device for Conducting Currents Thereto. D. N. Osyer, Newark, O. Filed Oct. 17, 1889.

575,641. Wire Couplers. W Gerard, St. Bernard, and J. H. Lawrence, Bond Hill, O. Filed Nov. 23, 1896.

575,653. Electric Condenser. J. C. Lee, Brookline; W. R. Westcott, Cambridge, and E. C. Robes, Medford, Mass. Filed July 8, 1896.

575,658. Galvanic Attachment for Eyeglasses. A. Mayer, New York, N. Y. Filed June 3, 1896.

575,668. Illuminant for Incandescent Lamps. A de Lodyguine, Pittsburgh, Pa. Filed April 10, 1894.

575,979. Magnetizing Box. C. A. Hussey, New York, N. Y. Filed Aug. 10, 1895.

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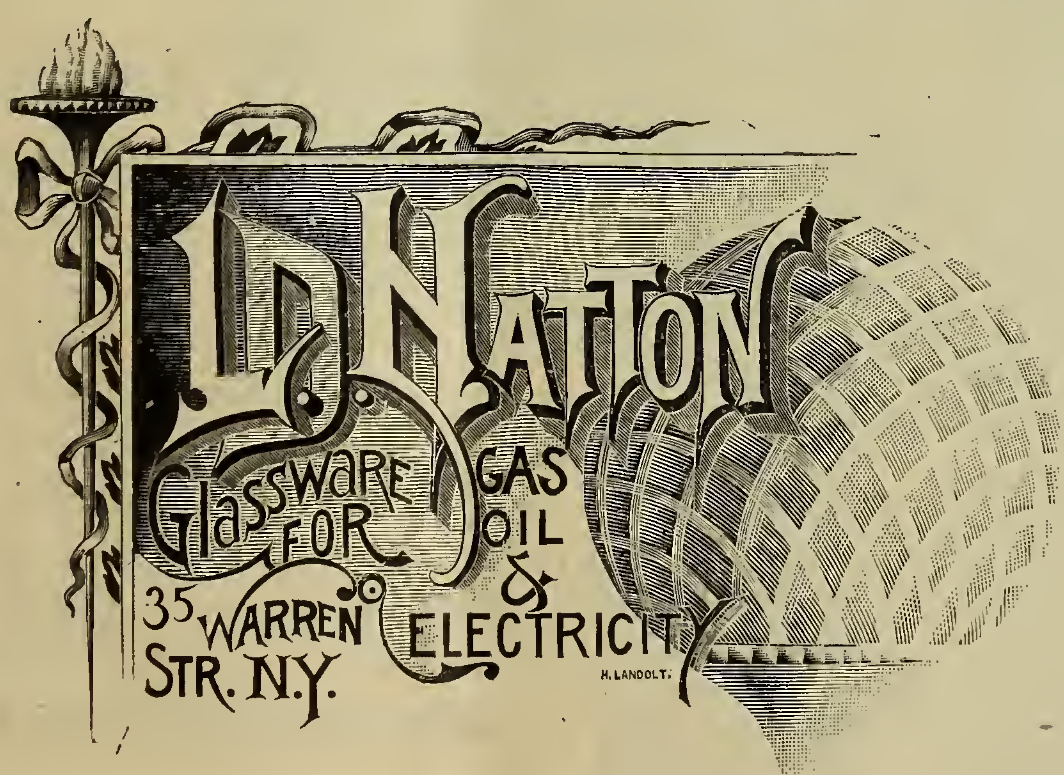

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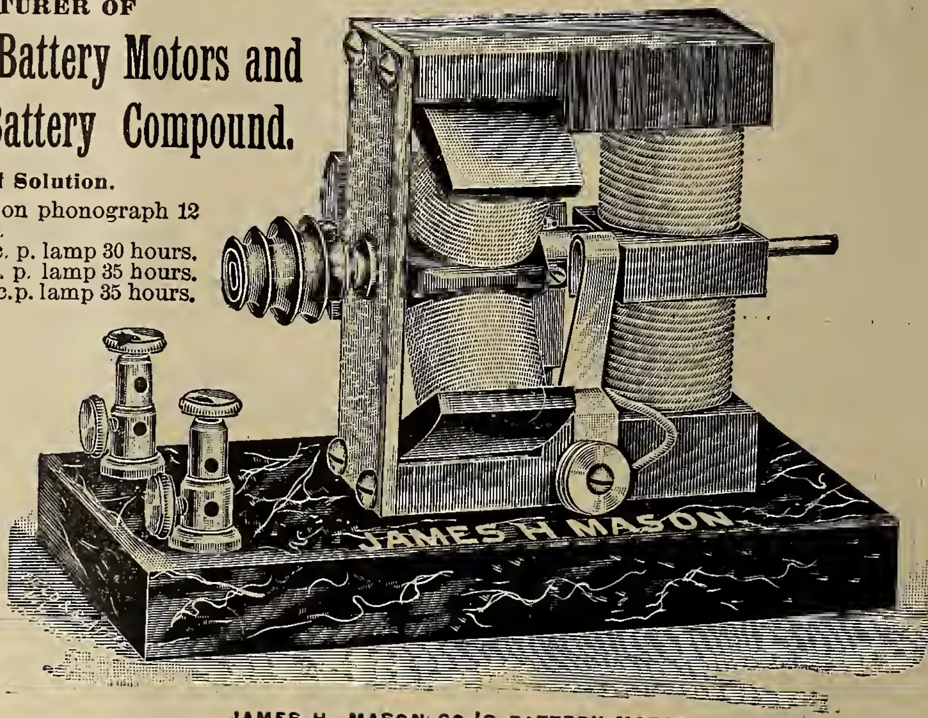

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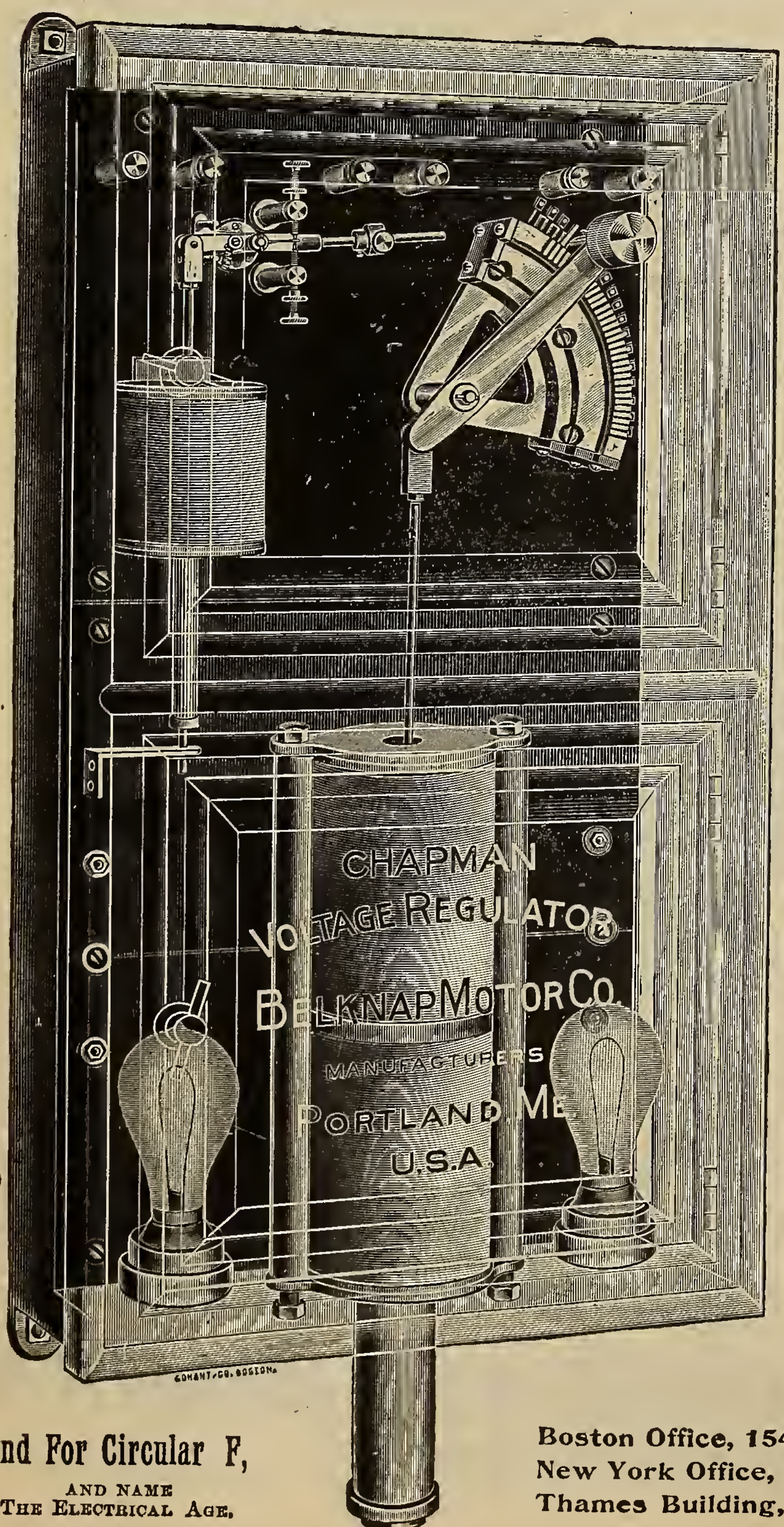

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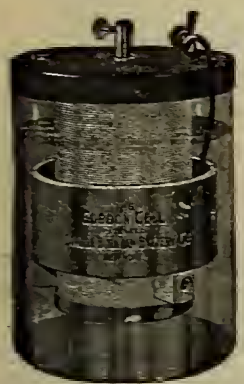

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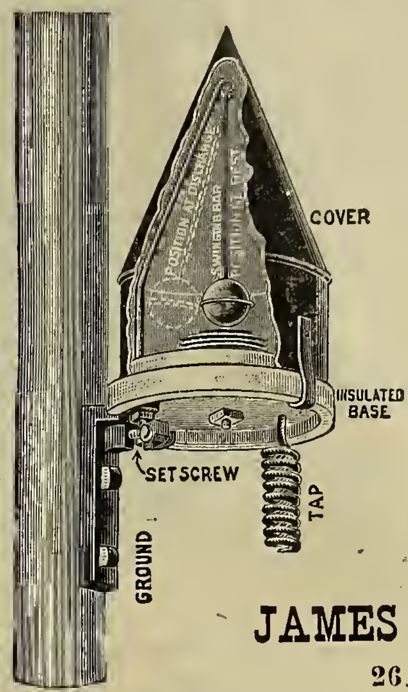

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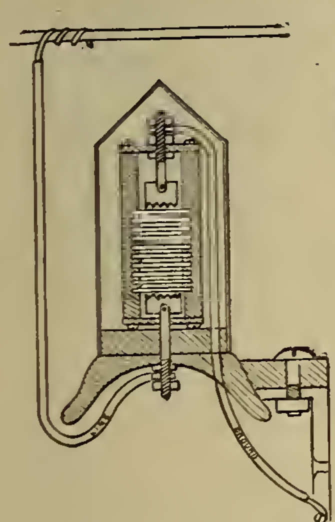

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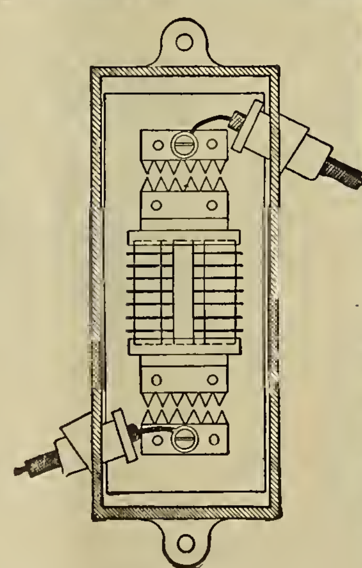

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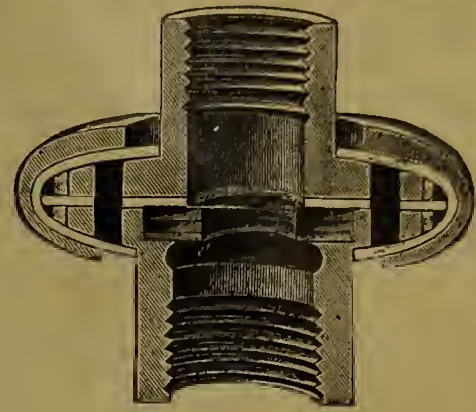

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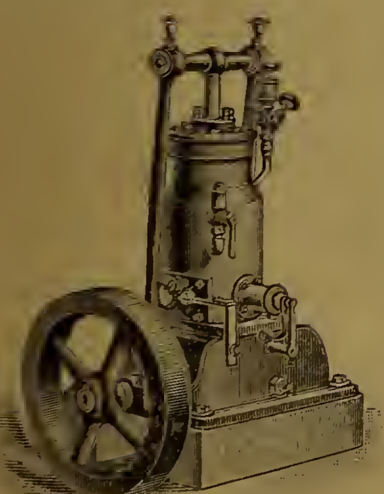

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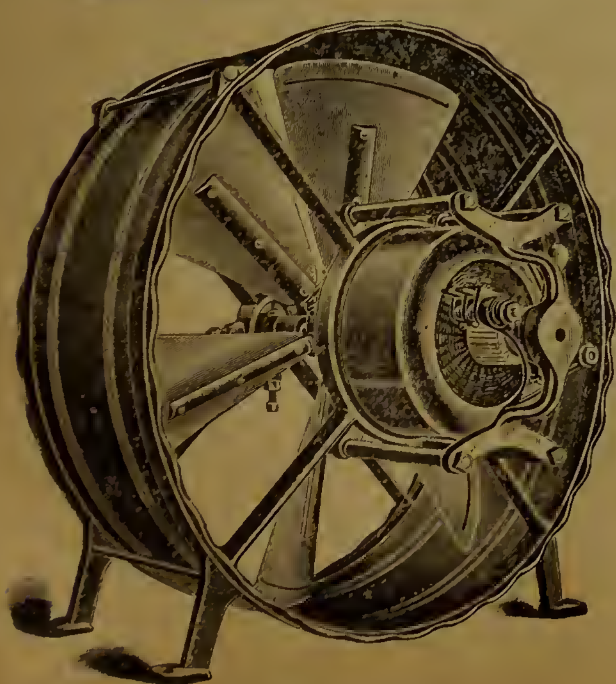

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